THE HISTORICAL ARCHAEOLOGY OF THE OIL AND GAS INDUSTRY IN WYOMING

A THESIS
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THESIS ABSTRACT

Thesis: The Historical Archaeology of the Oil and Gas Industry in Wyoming

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The history and archaeology of the oil and gas industry has received little attention in cultural resource management. The sites of early exploration activity are being destroyed rapidly due, in part, to the fact that field archaeologists and historians have not been educated on the scientific and historical importance of this industry to the American culture. This thesis is an attempt to begin the education process. The document begins with an overview of the historical developments on a national level and in the State of Wyoming. Attention is then focused on the physical remains that can be found in the field with guidance on the identification, interpretation, and evaluation of the remains. The thesis concludes with the development of research, designs and avenues of future inquiry.

ACKNOWLEDGEMENT

Many people have been involved in different phases of the development of this thesis. The support and encouragement of these people was greatly appreciated and contributed, in large part, to the final completion of this document. Although it would be impossible to name all these people, some individuals deserve special mention. I have greatly benefited from the time and effort put into my thesis by my committee. I would especially like to recognize Dr. Ronald Hicks for his patience and persistence. Carmel Swidler and Jude Carino of the Bureau of Land Management assisted in locating and identifying some of the sites discussed in the document. Dr. Ray Leicht and Kathy Gear, also of the BLM, allowed me to take time from work to conduct field research. Mark Cox drew the illustration of a cable tool rig on page 40 from an original illustration. The personnel of the Wyoming Archives, Museums, and Historical Department were very helpful in obtaining a number of the illustrations used in the thesis. Figure 1 (p. 23), fig. 2 (p. 30), fig. 8 (p. 46), fig. 10 (p. 51), fig. 13 (p. 58), fig. 14 (p. 59), and fig. 20 (p. 68) are used with permission from their collection. Special thanks goes to Janelle Penrod for typing the many drafts and revisions and to Debbie Fish for typing the final draft. I would like to dedicate this document to my father. Completion of this thesis would have been impossible without his help and support.

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CHAPTER ONE

INTRODUCTION

I.

The Wyoming landscape at the turn of the century was not very different than it is today. The energy industry was a major factor in the state's economy and people had become used to seeing the various types of facilities and equipment associated with oil exploration in their daily lives. This familiarity with the industry is still a pervasive factor today. The oil and gas industry is seen as a modern development and normally not considered something to get excited about. When compared to the many forts, Pony Express Stations, and historic trails that can be found throughout the state, the industry generates very little historical interest. It is possible that the historical interest is not there because the industry is active and alive today. Its importance is taken for granted. This is very unfortunate because the historical remains of the early exploration and development period are rapidly disappearing.

Early oil and gas exploration sites qualify for full protection under federal law but seldom benefit from it. Cultural resource specialists charged with preserving the past for the appreciation and understanding of the future are failing in their responsibility. They are not adapting to a continuously changing field. Many fail to recognize the historic importance of the oil and gas industry because their academic background has not prepared them to absorb new site types or categories. Others simply are not aware of the fascinating history behind the modern industry.

This document will attempt to educate the cultural resource specialist in three areas. First, it will present the historical development of the industry. An understanding of the history of the industry will provide a context against which to evaluate the individual sites. It will also serve to develop the basic terminology necessary to properly record and identify sites. The second section will move from the historical background to the identification, recording, and evaluation of sites that can be found in the field today. Thirdly, the understanding of the sites is taken one step beyond evaluation of significance to the presentation of possible avenues of research through the development of organized research goals and designs. These research designs and goals will, in turn, provide the basis for better evaluations. The entire document is oriented towards the historians and historical archaeologists who use this line of thinking on a daily basis in the field.

At this time, historical archaeology has the opportunity to apply its full range of techniques to a study of an industry that is becoming increasingly important in our changing times. Virtually everything that is used or touched in our daily lives has been formed or influenced by the American petroleum industry. This massive contributor to the economy is taken for granted by most of us yet none of our lives would be the same if it had developed differently or not at all. It is said that World War II was won, not by American boats, tanks, and planes, but by a wash of oil from American fields.

It is true that the demand for petroleum products created by the war did much to further the development of this fledgling industry, but even before this time the field was a showcase of American innovation and technology accompanied by a lifestyle every bit as wild and wooly as any attributed to the Wild West.

The industry has grown up and the daily episodes of this growth is all but forgotten as are many of the people who, in their own small way, contributed to the birth and youth of the giant. Sadly, these people are rapidly disappearing, taking with them memories of a way of life that can only be understood in terms of the unique circumstances that created it. A few attempts have been made to record their stories but these seem to concentrate on the lifestyle itself and minimize the technological developments that made it possible. What is needed is a historical overview of these technological developments with written records and field inspection of historical sites forming the skeletal structure to be fleshed out be personal narratives of people who worked in the oil fields, telling not only how they lived, but also how they worked, how they used particular tools and why.

Obviously, a task of this nature dealing with the American petroleum industry as a whole would be an undertaking well beyond the ability of even a small army of individuals. Nearly all of the 50 states have been touched by some form of oil and gas exploration and the problem is compounded by the scattered data. Therefore, this thesis will deal with only one state, which can be studied with the benefit of personal contact and firsthand information.

The state of Wyoming was an early contributor to the development of the American oil and gas industry. Wyoming's first producing well was brought in only fifteen years after Col. Drake completed the first successful oil well near Titusville, Pennsylvania, in 1869. Its growth as an oil producing state was initially very slow due to its remote location from cheap transportation and major markets. This remote location, however, forced Wyoming oil companies to become leaders in technological innovation. As parts and new techniques were slow to reach this area, companies were forced to develop their own. This resulted in a dynamic local industry which contributed greatly to the development of the petroleum industry on a national level.

In the course of my fieldwork since 1980 as a contract archaeologist in Wyoming, I identified several historic sites that did not fit the pattern of known types. Much of the observed debris consisted of tin cans, bottle fragments, ceramic fragments, and other varieties of historic debris that are commonly found scattered about the landscape and designated in the contract reports as "recent historic trash." Other artifact types were present, however, that did not fit the recognized pattern for this informally recognized site category: large wooden beams, firebrick, brick, ash, and a wide variety of metal and glass artifacts of unknown function. An opportune conversation concerning this puzzle led to further research, which eventually led to the identification of these sites as being directly related to early oil and gas exploration.

A quick review of some of the thousands of archaeological reports filed with the Bureau of Land Management in Wyoming revealed that several sites with these characteristics had been described in the reports, all dismissed as recent historic trash. In some rare instances the archaeologist recording the site did make a connection with the mining and/or energy industry. However, even in these all too rare occasions the recorder was not familiar with the range of variability in these sites and the way in which these sites may be evaluated. An effort was made to acquaint the archaeologists and historians at the state and federal level with the necessity of giving sites connected with oil and gas exploration a priority in the research goals of the state. It soon became clear that even with this increased awareness sites of this type cannot be adequately recorded or protected without a better appreciation of the historical development on the national and state levels. A classification system is needed with which to organize the variety of related sites, and the methods for dating and identifying these site varieties must be provided to those archaeologists and historians working in the field so that the remaining sites can be recorded and identified as such.

It is extremely important that a concerted effort be made to evaluate those few sites remaining due to the rapid rate of disturbance. These sites tend to be located in and near areas of active energy exploration, a fact which has tended to accelerate their disappearance. Prior to the advent of modern contract archaeology, those locations which were in or near active fields were "cleaned up" or bulldozed to make way for newer equipment and facilities. Whole townsites and thousands of drillsites and camps have disappeared in this way. As a large number of those remaining sites are from the turn of the century, it was common for them to be ignored by archaeologists because they were not considered to be "old enough." This is unfortunate as these sites still have a great deal of information to offer that can be found in few other ways. A fair amount of information is available on the general history of the petroleum industry, yet virtually nothing is available on the technological changes and developments that shaped this history. Information pertaining to any aspect of the petroleum industry in relation to the state of Wyoming is limited to the Salt Creek and Teapot Dome fields along with isolated articles in specialty publications.

As material remains are the stock and trade of the field archaeologist and historian, this lack of available information is a real detriment to on-site evaluation and identification. There is still time to record this information. The technological development of the industry can be pieced together from on-site data and written documents. An even more important resource must be recognized and utilized although this resource is disappearing as fast as the sites on which they worked. This resource is the people who worked in the fields and contributed to the development of the industry. Very few of their stories have been recorded and a vast wealth of knowledge is being lost.

This loss of data can only be stemmed through the education of cultural resource specialists in the role of this industry as a major contributor in the development of American history, in general, and the history of Wyoming in particular. The study of this industry at this time is particularly important due to the extreme fragility of the resource base. In order to assist specialists in the evaluation and identification of these sites, this thesis will attempt to provide a comprehensive background of the technological and historical developments associated with the development of the industry. Chapter Two will provide a summary of the historical and technological development of the industry on a national level. This chapter will concentrate on the technological development because much of what happened on the national level is reflected on the local level in the types of artifacts that are found in the field. Chapter Three provides a historical background for the state of Wyoming. This is necessary to properly evaluate the sites in terms of the historical context. Chapter Four will provide a summary of the types of sites that can be found in the field. The material provided in the earlier chapters is important for a complete understanding of the site types and their evaluation. The material presented in Chapter Five will build on the information in Chapter Four and present guidelines for the identification and evaluation of historic oil and gas sites in the field. Chapter Six identifies some of the research designs and questions which can be used to evaluate the scientific significance of early oil and gas sites and Chapter Seven is a short summary of the points made and an identification of some areas to pursue in future research.

By presenting the information in this way, it is hoped that the reader will have a better understanding of how to properly identify and evaluate historic oil and gas sites in terms of the importance of the industry in Wyoming to the development of state and national history.

CHAPTER TWO

DRILLING FOR OIL

On August 28, 1859, the American petroleum industry was born in Titusville, Pennsylvania. E. L. Drake had been attempting to drill for oil for over a year, virtually exhausting his resources as well as the patience of his backers. A few months after acquiring the services of an experienced salt well driller named "Uncle Billy" Smith and several days prior to receiving a letter from his backers (the Seneca Oil Company of Connecticut) ordering him to abandon the operation, oil was discovered at a depth of 69.5 feet (Williamson and Daum 1959:77-80). Using the proven techniques of the salt drilling industry, Drake had shown that oil could be produced in commercial quantities through drilling. This discovery was soon followed by a tremendous explosion of drilling and land speculation with one success after another, which assured the growth of this new industry.

Oil had been known in the New World from as early as 1526 when thick petroleum deposits were reported in Cuba. This site became a frequent stopping point for Spanish ships which used the "asphalt" to pitch the ships keels. The medicinal and construction values of petroleum had been known in the Old World since at least 3000 B.C., and it was not long before the American petroleum resources were utilized in the same way. In 1566 a Spanish doctor, writing on important medicinal products imported from America, listed fountains of "black pitch" from the island of Cuba as good for "griefes of the Mother." It is known that the Incas and other indigenous populations had been using American petroleum in their medicines long before its discovery by European explorers (Williamson and Daum 1959:8-10).

The New World settlers quickly learned of nearby oil springs from the local Indians who reported remarkable healing properties for this black liquid. The fact that this sticky ooze was frequently an unwanted by-product of salt well drilling led some entrepreneurs to market it under various names and for many different uses in order to save their investment. Soon virtually all people were using petroleum in some part of their lives, whether to lubricate the axles of their wagons, to illuminate their homes, or to cure a myriad of ills. A widespread industry developed in which demand soon outstripped production, a situation which led Mr. Drake to assume that money could be made by drilling for oil.

Knowledge of the usefulness of oil was carried with the settlers as America began its westward expansion. Early explorers had reported that great oil springs were to be found in the territory which was to become Wyoming. One of the first reports of oil in Wyoming is found in Washington Irving's book "The Travels of Captain Bonneville" (1837) in which Captain Bonneville is directed to a "great Tar Spring" near the base of the Wind River Mountains. The Indians told of the great medicinal properties of this tar and the weary travellers used it as a liniment for their aching muscles and as a balm to soothe the saddle sores of their horses. Coincidentally, this area also provided the easiest route through the Rocky Mountains and so became the primary travel corridor west.

Thus the oil came to be used as an axle grease for travellers on the Oregon and Emigrant Trails. Such well known figures as Jim Bridger, Kit Carson and Brigham Young mixed up concoctions using the oil and sold it to the emigrants as axle grease. By the late 1800's oil in Wyoming was used for virtually everything. Gus Powell used oil in the Glenrock area to:

> grease the flippers of his Fresno scrapper (a dirt mover pulled by horses), wipe his flapjack griddle with it, polish his tent floor, grease his beaver slides, and it was a fine gun grease. He even used it for gun patches. It was also useful for starting fires under Dutch Ovens, as an oil for mowing machines, and the ladies in the area combed it through their hair since it hid any grey that might peep through their Victorian tresses (Bragg 1976:181)

Thus the adaptability of oil to solve nearly every problem gave impetus to a thriving industry long before Henry Ford and his horseless carriages, and this industry had spread to Wyoming well before the introduction of drilling transformed it.

Although the Drake well was the first attempt to actually <u>drill</u> for oil, its construction used a technology that had been developing for a long time. Techniques for extracting liquified materials from the earth had been developed over thousands of years. The earliest known attempts to dig into the earth were made to obtain a usable water supply. These water wells were dug by hand using shaped sticks and crude tools and throwing the dirt out of the hole. Later, as the holes got deeper, baskets of skin or fiber were used to haul the dirt out, and with the invention of the wheel in Sumeria around 5000 B.C., the pulley and windlass were probably used (Brantly 1971:2). The digging of wells by hand was accomplished by one man pounding the bottom of the hole with a chisel and loading the debris into a container for the rest of the crew to haul out. As the hole got deeper the walls were "cased" or shored up with wood or brick (Stockil 1977:91). The digger was hauled up in the same manner as the debris whenever the producing zone was encountered. This method was very slow and extremely dangerous for the digger, especially in the case of digging for oil where the first encounter with natural gas and oil could quickly overwhelm him. This method was used throughout the world from prehistoric times until very recently, when it was all but abandoned for more expedient methods. The Burmese used this method to dig for oil from A.D. 1600 until about 1910 (Brantly 1971:4; Stockil 1977:92) and several examples are known in Wyoming from the mid to late 1800's.

The first major improvement in the hand dug method was called the "springpole" method, using direct percussion to bore the holes. This method was first developed by the Chinese for drilling brine wells prior to 600 B.C. (Brantly 1971:41) and later redeveloped in Europe and America at the end of the eighteenth century (Stockil 1977:92). The American Springpole Method was developed around 1806-08 by the Ruffner Brothers on the right bank of the Great Kanawha River within the limits of what is now Charleston, West Virginia. This well is the first well known to have been "drilled" in the western hemisphere and initiated the brine well drilling industry of today (Brantly 1971:64).

The actual construction of the springpole depended on the availability of materials and as a result, there was a great deal of variability in style, but the principle remained the same. In essence the procedure developed by the Ruffner Brothers was as follows: The well was hand dug to bedrock and simultaneously cased (the Ruffner Brothers used a 17-foot long by four-foot wide hollow sycamore tree trunk to case their well). An innovation developed by Drake consisting of the sinking of a metal pipe from surface to bedrock allowed the elimintion of this step (Williamson and Daum 1959:78). The hole was then "spudded," or started, using a tool very similar to the rock quarrying tools of the time. The springpole apparatus consisted of a small tree, approximately 20-25 feet in length, the butt end of which was set into the ground at an angle in such a way that the upper end of the pole extended over and slightly past the proposed drill hole. A forked pole was set up beneath this about seven feet from the butt end and of sufficient height to set the upper end of the pole approximately six to seven feet above the ground surface. A short rope with a loop (or loops) at the end was fastened to the pole. The driller (or drillers) would put his foot in the loop to provide power. A longer rope was wrapped around the pole near this point with one end attached to the drilling tool.

To operate the springpole, the driller would push down on the loop and then release thereby jerking the drilling tool (or "bit") into the air. The impact of the bit hitting the ground would fracture the surface. A small amount of water was always kept in the hole to keep the fractured particles in suspension so that the drilling could go on longer before the debris had to be removed. In order to do this, the bit was removed and a self-sealing container, called a "bailer," was lowered to remove the cuttings, then the process was repeated. (The description provided here has been simplified from Brantly 1971:73-74 and Stockil 1977:92).

Using a very similar method, the Chinese are said to have drilled wells to depths in excess of 1000 feet although the American wells were seldom more than 250 feet. The depth of the well was limited by the amount of weight that the pole could support. This had to include the weight of the rope which increased as the hole got deeper. If the rope broke, the driller would need to improvise a tool to recover the bit. The process was called "fishing" with the lost bit being the "fish." The drill bits were rapidly dulled in the drilling process and the driller had to continually pull the bit from the hole to resharpen it in a makeshift forge at the drill site (Stockil 1977:92).

The springpole method was used for a long period of time, even after newer methods became available, due to the inexpensive nature of the necessary materials. It was, however, a long, slow process and so proved to be economical only where shallow holes were required.

Developments in direct percussion drilling included the building of a small tower or derrick as an aid to handling the longer lengths of pole and rope needed to drill deeper wells. Using a series of wheels, pulleys and brakes, a new method of drilling deeper wells evolved. This method, called the "cable tool" method had been developed as early as the seventeenth century in China (Brantly 1971:488-489). Although there is probably no historical connection, the cable tool method later developed in

Europe in the late 1700's and early 1800's (Brantly 1971:494).

The next major development occurred when the fulcrum of the springpole was moved to the center of the pole. Power was then applied to one end and the tools hung from the other end. The drilling was accomplished by the up and down motion of the end of the pole or beam. The unusual appearance of this motion soon gave this apparatus the name "walking beam." One of the earliest walking beam rigs known is a Canadian rig built by W. H. MacGarvey in the 1860's. Another variety of the walking beam is known from the Drake well. In this case the beam was hinged at one end with the tools hung from the center of the beam in an arrangement very similar to the springpole structure. This arrangement, called the Grasshopper walking beam, is very unusual (Brantly 1971:503-504).

In and around 1850 a general trend towards mechanization was spreading through American industry. Efficient, portable steam engines were developed which provided a long, regular, reciprocating motion to the bit and greatly increased the amount of weight in cable and drilling tools that could be utilized in drilling, increasing the effective drilling depth of rigs (Stockil 1977:93-94). The addition of the steam engine greatly increased the efficiency of the rig and completely replaced human and animal power. The application of this new development was enhanced by the development between 1862 and 1873 of the variable speed or adjustable cutoff. This apparatus increased the fuel economy of the engine by using full steam pressure only during part of the stroke of the piston, letting expansion of the steam carry the stroke to completion. It also helped reduce fuel consumption where pumping operations were operated from a single power unit or where several engines drew upon a central boiler for their steam, allowing wells to be added or withdrawn from pumping without loss of efficiency of operation of the central power unit (Williamson and Daum 1959:141-142). The use of the steam engine in combination with higher derricks also streamlined the daily drilling operation:

> The derrick had to be high enough to accommodate the strings of drilling, bailing or fishing tools before they were lowered into the hole. By keeping several strings on hand it had become a relatively easy task to hoist out the bit, run in a bailer, remove the cuttings, and get a sharpened bit back in to continue drilling the hole (Stockil 1977:94).

By 1873, the Grasshopper walking beam and springpole had effectively been retired from field production and replaced by walking beam cable tool rigs (Williamson and Daum 1959:137). A great deal of variety existed in the construction of various parts of the rigs as they usually had to be built on the spot by men called "rig builders" with little regard for consistency from rig to rig. This led to a major problem with obtaining spare parts and the industry and suppliers gradually began to produce parts uniform in size and shape. Around 1880 a standard rig design and parts size were developed that gained such universal acceptance that in 1890 this rig became known as the Standard Cable Tool Rig, remaining the mainstay of the drilling industry until around 1930 when it was replaced by the new rotary method (Brantly 1971:505). The rig type changed little from 1890 to 1930. Among the changes that did occur during this forty year period, steel gradually replaced wood as the building material for derricks, bits were made larger (a 24-inch bit weighed over 1.5 tons) and steel casing was used to shore up holes drilled in soft rocks, The most important development of this time was the cementation of casing. In 1903, cement was first used to seal the casing in place, preventing leakage and costly delays while bailing (Stockil 1977:93). The cable tool rig was best suited for medium hard rocks as those holes drilled in softer rocks were subject to cave-in due to the constant pounding of the drill bit.

By the late 1870's and 1880's westward migration of homesteaders was reaching the Dakotas and other areas with relatively low rainfall. Those areas with a permanent source of water were quickly claimed leaving newer arrivals to depend, for the most part, on wells to supply their needs. Hand dug wells could not always reach water and percussion tool rigs had extreme difficulty handling the unconsolidated clays, silts, sandy clays and sands that predominated in the region. Thus, if any large scale settlement were to occur, a new method for drilling was needed. In the early 1880's two experienced water well drillers in South Dakota, M.C. and C.E. Baker, were attempting to solve the problem. Given the difficulty of drilling in this area, they conceived the idea of drilling with fluid circulating through the hole (Brantly 1971:209).

> They kept the upper end of the drilling shaft, or drill pipe, as high above the ground level as was practicable. They undoubtedly used a tower of some type. From this tower and from a windmill, they introduced water into the hollow drill shaft... to move the cuttings to the surface up the annulus and to discharge them into a surface pit (Brantly 1971:210).

The Baker brothers moved southward with their tools, drilling water wells as they went, until they reached Texas in the early 1890's. From their work in South Dakota, they had developed a tool later called "grip rings" which rotated the drill pipe and allowed it to move downward as the bit made the hole (Brantly 1971:211). By the late 1890's several individuals had developed rotary drilling equipment using the Baker's hydraulic principle and grip rings. Although several workable patents had existed since the 1860's, four major drilling machines were available in what was to become the great Corsicana Field of Texas. Three of these, the Chapman, Johnston, and Parker rotary tables, were based on the Baker method. The fourth, the Cameron table, soon disappeared due to several weaknesses in design (Brantly 1971:213).

The rotary systems, which simply consisted of rotating the bit at the end of a steel tube, soon proved to be most efficient in those areas where the cable tool system was weakest. It was able to move rapidly through unconsolidated materials and softer rocks and, with the discovery of oil in the Spindletop well in the Corsicana field in 1901, it soon dominated the Gulf Coast (Stockil 1977:95).

In principle, the rotary system has changed little since that time. The derrick is used as a crane with a hook, block, tackle, and hoisting drum (called the drawworks). The bit is suspended from the hook on uniform lengths of pipe called drill pipe with the entire length called the drill string. The top of the drill string slides through a rotary table which is turned by the engine to rotate the bit (Stockil 1977:95-96).

The early rotary machines had trouble penetrating hard rock layers, and drillers had to spend a great deal of time, effort, and money in these areas. In response to this problem several manufacturers developed combination rigs which had the capability of rotary drilling through soft layers and percussion drilling through hard layers. These rigs had the disadvantage of being costly and cumbersome and sometimes required experienced cable tool drillers as well as rotary drillers. Some portable machines were developed but the need for combination rigs was soon eliminated with the invention of the Hughes Simplex rock bit by Howard R. Hughes in 1908-1910, the forerunner of the cone type bits used today (Brantly 1971:262-263).

The onset of the Depression brought drilling activity to a virtual standstill for over two years during which rig manufacturers were designing new outfits. When production resumed, the drilling industry was much more competitive and rigs were being required to drill deeper than ever before to reach new levels of oil bearing sands. At the time, percussion rigs were able to drill a maximum of around 60 feet per day under excellent conditions, whereas the rotary rig, under similar conditions, can now drill up to 2000 feet in eight hours (Stockil 1977:95). Sheer economics sounded the death knell for the cable tool system as the predominant method of drilling in the oil field.

There are many developments, individuals, and changes that led to the modern drilling industry, but these are beyond the scope of this simple introductory history. Probably the best detailed source for technological development would be Brantly (1971), who not only discusses the general historical development but also deals in depth with changes in the individual components which make up the different varieties of drilling rigs.

The drilling industry has had a tremendous influence on the development of American history. From its early role in providing a constant supply of water and salt for men and animals, and medicinal petroleum products on the East Coast, it spread across the country giving access to water for homesteaders in otherwise barren areas as well as energy to fuel their fires and for fledgling industries. The development of the American economy created a demand for new sources of energy. The discoveries of great fields of oil and gas in the western states led large numbers of people west in search of their fortunes and, after the boom died down, many of them stayed on as permanent residents. The development of the petroleum industry was another important, yet frequently overlooked, factor in the development of American society. It is certainly important to the economic and political histories of many western states by virtue of their larger shares of petroleum and other energy resources.

Unfortunately, a detailed discussion of the historical importance of the industry to American history would be an enormous undertaking, one which is well beyond the scope of this thesis. No cultural resource specialist who encounters the remains of oil and gas activity in any state can even attempt to provide an adequate evaluation of that site's significance without some understanding of the role of the industry, as a whole, in the development of American history. This chapter has provided a general overview of the major trends and developments in this

Knowledge of this spring and successes in other parts of the state provided the incentive to explore the remainder of the basin. A readily available supply of coal provided a cheap source of fuel to power drilling rigs, but the lack of access to markets and remote location hindered any concerted effort to develop any oil discoveries. Due to their smaller size and mobility, portable drilling rigs were used in the vast majority of locations (Hewett and Lupton 1917:25). Drilling was confined primarily to those areas immediately surrounding oil seeps from 1884 to 1906, when attention began to be focused on the many anticlines in the basin (Hares 1947:199-200).

Gold mining in the Black Hills of Wyoming and South Dakota provided a major incentive for petroleum exploration in the Powder River Basin. Over a dozen seepages in the Moorcroft area had been exploited to provide a good supply of lubricating oil for nearby mining towns such as Deadwood and Lead (Figure 2). Oil was in such demand that it sold for $28.00 per barrel and by 1887 over 60 wells had been drilled in the area, establishing the first oil field in the Powder River Basin (Strickland 1958:132). Numerous oil seeps were known to exist along the margins of the basin from the earliest accounts; they were often utilized for medicine by Indians and for fuel oil, lubricants, road dressing, and as an insecticide for the painting of fruit trees and hen houses by the early settlers and miners (Strickland 1958:132).

During this same general time period an interest was developing in numerous oil seeps in an area of "sparse grasslands, alkali creeks and oil film on soda lakes" that had been all but industry on the national level. The next chapter will narrow the scope of focus to cover only the historical developments in the state of Wyoming. This statewide emphasis will provide a better understanding of the importance of the remaining oil and gas sites found there and provide a background for their comparative analysis.

CHAPTER THREE

WYOMING OIL: THE FIRST 100 YEARS

The preceding chapter outlined the broad technological changes that have taken place in the American petroleum industry. The physical limitations of each of the drilling methods combined with the true "pioneer" nature of much of the early activity in Wyoming has served to assure that virtually every conceivable method has been used to find, extract, and refine oil and gas in the state. We can find evidence of hand dug wells and spring-pole, cable, and rotary drilling rigs as well as a whole range of support facilities from field camps and small 50-gallon capacity refineries to whole townsites and massive refinery complexes. Each of these sites can provide different types of information on the social and technological development of the modern state of Wyoming.

In 1984, Wyoming celebrated the centenary of its petroleum industry, which began with the drilling of the Murphy Well in what is now the Dallas Dome oil field in 1884 (Figure 1). This well became the state's first commercial producer of oil and helped to pave the way for many more. But the search for petroleum did not begin with the coming of the White Man. The Indians had probably been using the oil found in the numerous seeps which dot the Wyoming landscape ever since they first moved into the area. Documentation for the ancient use of oil is virtually nonexistent for Wyoming, but nearly all populations located near

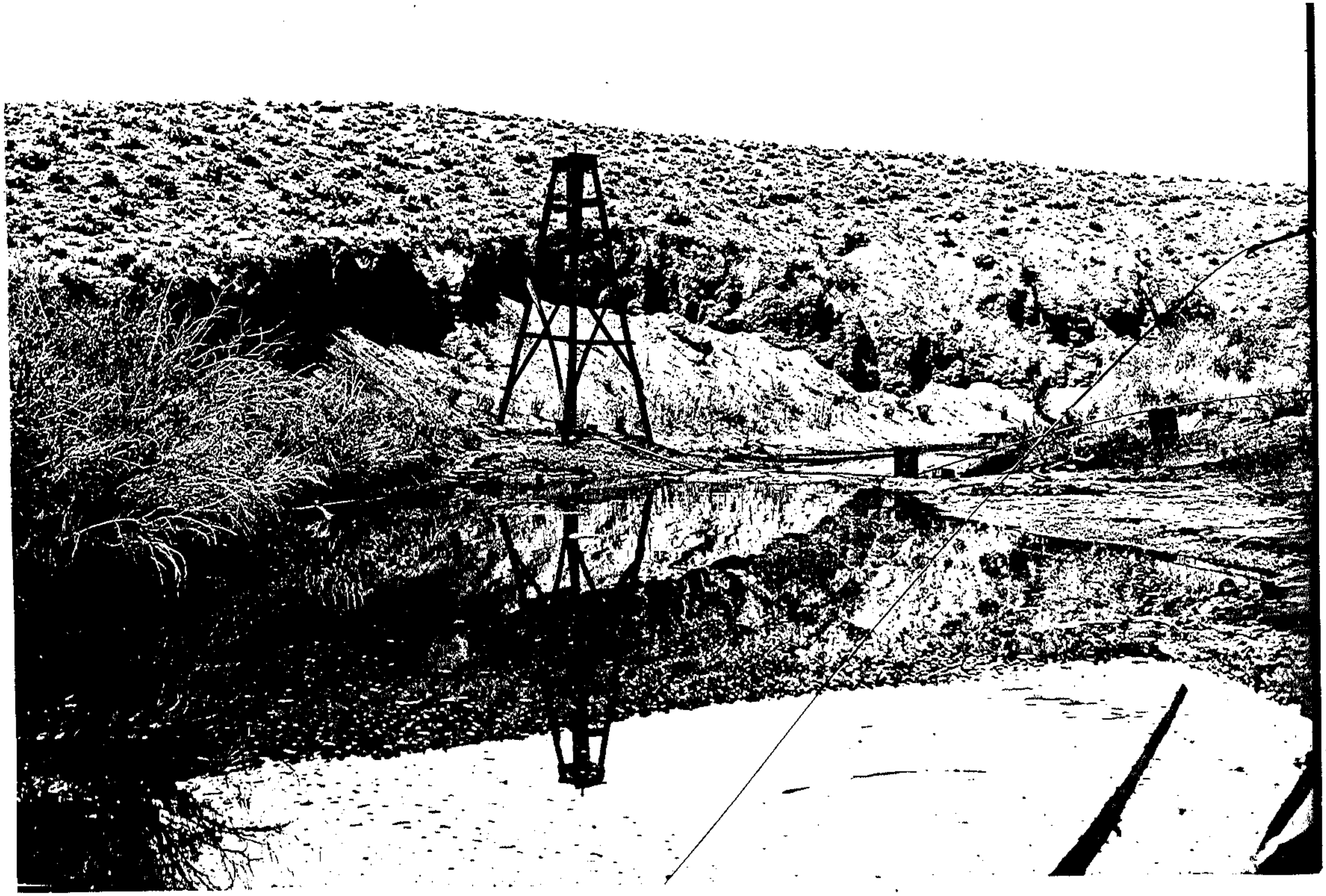

Figure 1. Murphy Well, the first producing well in Wyoming (1903)

the oil seeps that occur all over the world have been greatly affected by them. For example, people in the Near East developed a myriad of uses for the black substance oozing from the ground. Many of these seeps caught fire and the resulting "eternal flames" were often given religious significance. "The traditional fate of Sodom and Gomorrah may well have been linked to the old seepages abundant along the southern borders of the Dead Sea" (Tiratsoo 1973:2). It is known that the Indians of Wyoming used oil as medicine or in ointments and to mix the paints with which they decorated their bodies (Roberts 1956:7). Numerous accounts exist of the medicinal use of oil by Indians and in some of the eastern regions it was a minor trade item which they collected in any available container and traded to the whites for other goods (Williamson and Davis 1959:12). Although we lack published reports on the importance of this resource to the local aboriginal economy, it may eventually be possible to get some idea of the extent of its use from archaeological site distributions and densities around known oil seeps.

One of the earliest reports of petroleum in Wyoming is included in the biography of James Clyman, a trapper and explorer. Here the book reports that as early as 1824 trappers noted the petroleum seeps near the Popo Agie River. Some collected the oil for medicinal uses and at least one party celebrated by setting the oil spring on fire to watch it burn (Camp 1928:21-22).

Another early incident involving the use of petroleum in Wyoming is mentioned in Captain Benjamin Bonneville's report to the War Department in which he tells of being directed to a large oil seep, or tar spring, in 1833 by his Indian guides (Espach and Nichols 1941:2). Washington Irving, in his book "The Adventures of Captain Bonneville", described the occasion as follows:

> After a toilsome search, he found it at the foot of a sand bluff, a little to the east of the Wind River Mountains; where it exuded in a small stream of the color and consistency of tar. The men immediately hastened to collect a quantity of it, to use as an ointment for the galled backs of their horses, and as a balsam for their own pains and aches. From the description given of it, it is evidently the bituminous oil, called petroleum or naptha, which forms a principal ingredient in the potent medicine called British Oil (Roberts 1956:8)..

The knowledge of the location of oil seeps and their use by early trappers as a medicine and ointment and for numerous daily applications led to the first large scale use of Wyoming oil. It was used as a "rust preventative, for softening up moccasins, keeping saddle leather pliable, gun patches" and any number of other uses (Bragg 1976:181). As the beaver were rapidly disappearing, the trappers were increasingly becoming guides for military expeditions, survey parties, and emigrant wagon trains as a means of livelihood. The many uses of oil would have made the seeps attractive stopping points for groups whose supplies were getting low and whose need for medicine, liniment, and (perhaps most importantly) axle grease was becoming great. It may be no coincidence that the Overland, Mormon, and Oregon trails are very closely related to areas of oil seeps. There are several written accounts of the exploitation of seeps in connection with historic trails. The earliest of these are probably the accounts of Brigham Young's 1847 trip to the Great Salt Lake. The group stopped near an oil spring in the NW1/4 of Section 4, Township 13 North, Range 119 West, in southern Uinta County to grease the axles of its wagons and collect oil for medication (Espach and Nichols 1941:3). One member of this party published what became known as the "Mormon's Guide Book," which described the site for later travellers:

> About a mile from this place (the crossing of the trail over Sulphur Creek) in a southwest course, is a "tar" or "oil spring" covering the surface of several rods of ground. There is a wagon trail running within a short distance of it. It is situated in a small hollow, on the left of the wagon trail, at a point where the trail rises to a higher bench of land. When the oil can be obtained free of sand, it is useful to oil wagons. It gives a nice polish to gunstocks and has been proved to be highly beneficial when applied to sores on horses, cattle, etc. (Clayton 1948:29).

This spring was mentioned in several early reports (Engleman 1859; Stansbury 1852) and was undoubtedly well known to the trappers who first built Fort Bridger. Veatch (1906) reports that Brigham Young had a shallow well dug (probably by hand) near the seep, which became known as the Brigham Young oil well or spring. He goes on to state that the oil was skimmed off the surface of the water in this well, sold to emigrants and carried in small quantities to Salt Lake City.

In 1851, several other famous frontiersmen were involved in the oil business. Kit Carson, Jim Baker, and Cy Iba were all involved in the sale of oil from seeps on Oil Mountain and along Poison Spider Creek to travellers passing through what is now the Casper area along the Oregon Trail (Roberts 1956:8). Espach and Nichols (1941:76) state that a seep in Section 28, Township 33 North, Range 82 West, Natrona County, was "located and owned by Kit Carson, Jim Baker and half-breed Indians who transported the oil on ponies to the California (Mormon) trail; here it was sold at one dollar per quart to freighters and emigrants who mixed it with flour and used it for axle grease." Several shallow holes and pits were dug or drilled by "springpole" near the seep around 1895 with poor results. Jim Bridger may also have been involved in the sale of oil from Oil Mountain seeps at one time as has been reported, but there is no verification of this (Love 1978:61; Wilkins 1958:17; Bragg 1976:181). Cy Iba was later important in the opening of the massive Salt Creek Oil Field, whose seeps had become regular stops for freighters on the Bozeman Trail. One of the earliest reported Indian incidents connected with oil prospecting is reported from the Salt Creek region in 1873 (or 1874) in which:

> a freighter, John Hutton, and two companions, Mitchell LaJunesse and Baptiste Garnier, were filling a glass jar with oil at a seep in the Teapot Dome area. A party of Arapahoes, of about 30 mounted men, appeared suddenly. They talked briefly and seemed friendly. The mounted Arapahoes vanished as suddenly as they had appeared. They left a message with LaJunesse, the half-breed interpreter - "Get out and don't come back" (Bille 1978:1).

In 1882, Captain Bonneville's oil seep gained additional importance when Mike Murphy became interested in drilling for oil on his property. He arranged for a cable tool rig and driller to begin drilling for oil on a spot adjacent to the seep (Landmichl n.d.). The well, which was drilled 300 feet into the rock and began production early in 1884, was located in the SW1/4 of the SW1/4 of Section 13, Township 32 North, Range 99 West (Love 1978:62). The oil from this well was hauled from the field in barrels and was originally used in flour mills at Lander and Milford. An early steam power plant in Lander was also fired by the oil (Murray n.d.). Although the wells were shut in a few years after they began production due to a lack of steady markets, they were able to provide a great deal of encouragement to those exploring for oil in other parts of the state. In 1880, the first exploration of oil is recorded for the Big Horn Basin at an oil seep near the Bonanza Post Office on a tributary of No Wood Creek. Edward Lloyd is said to have discovered the oil spring in 1884 (Hares 1947:199; Wilkins 1958:17). Hares (1947) locates this spring in Section 23, Township 29 North, Range 91 West, but Lupton (1916) places it in Section 26, Township 49 North, Range 91 West. Knight (1903) describes an instance in which this spring became very important to inhabitants of the Big Horn Basin:

> One very hard winter in the eighties the supply of kerosene oil gave out in the Bighorn [sic] Basin and the crude oil from the Bonanza Spring was burned in the lamps by many settlers. It was a very good substitute and has always been praised by those who actually used it for illuminating purposes.

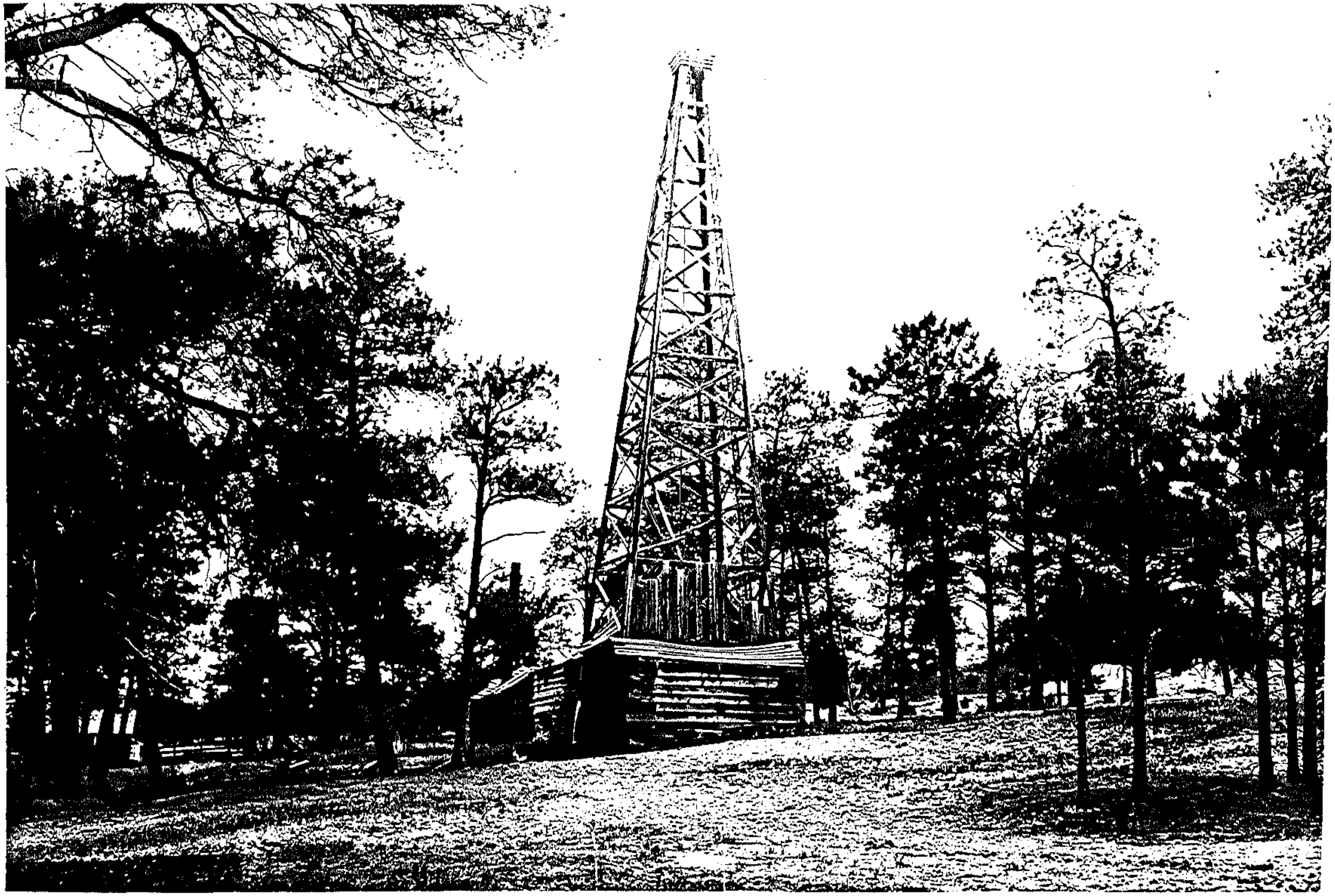

Figure 2. Standard Cable Tool Oil Rig Near Newcastle, Wyoming (1903).

ignored by cattle ranchers and sheep herders (Bille 1978:7). Men such as A.T. Seymour and Cy Iba who had long been promoting gold and petroleum prospects in the Rocky Mountain area began pursuing prospects in this barren area, which had been named Salt Creek due to its alkali water. They filed numerous claims in the area and attracted the interest of established oilmen from Bradford, Pennsylvania, who arranged to drill a well under the direction of Mark P. Shannon. Their equipment was shipped by rail to Laramie and then freighted 200 miles across country to Casper and Salt Creek by a 16-horse freight outfit (Wilkins 1958:17). The drilling of the first well was started in the fall of 1889 and after 1000 feet of tedious work with a standard rig the well was completed as a 10 barrel per day "gusher." Shannon soon drilled three more wells near this discovery well at the same time that Wyoming was admitted to statehood July 10, 1890 (Roberts 1956:19; Wilkins 1958:17; Bille 1978:9). Freight teams were used to haul the oil to Casper. Initially the oil was carried in ordinary barrels but Shannon soon developed a special wagon with two small wood stave tanks fastened to its bed. While awaiting transport, much of the oil was stored in wood stave tanks or open lakes created by damming intermittent drainages or depressions (Bille 1978). Shannon's group (now known as the Pennsylvania Oil and Gas Company) built the first refinery in Casper in 1895. This was soon followed by the area's first pipeline from field to refinery (Wilkins 1958:17). The success of the Pennsylvania Oil and Gas Company attracted investors from around the world: Colorado investors formed the Midwest Oil Company in 1910 and built a second refinery and pipeline (Wilkins 1958:17). Renewed interest was developed in existing fields and potential producing areas throughout the state. The rush of capital, men, and material started by Shannon's discovery was limited by one major factor--access to markets. Many parts of the state were so remote that the economic costs of development could not be sustained after the initial discovery and these wells were frequently "shut-in" or closed off until the transportation network could be extended into these areas.

While most new discoveries were being shut-in due to lack of transportation, Salt Creek was booming as a result of demands produced by the World War I oil market. This demand peaked in 1917 and shortly afterwards the entire area was rocked with the development of the Teapot Dome scandal when the Secretary of the Interior, Albert B. Fall, was convicted of taking a bribe from the Mammoth Oil Company organized by Harry F. Sinclair. Sinclair attempted to obtain favorable oil leases in the Teapot Dome Naval Oil Reserve (Bille 1978:102). The depressed market for oil, lack of transportation facilities, and legal scandals contributed to the fact that Wyoming was not able to compete with the more established markets for oil. Crude oil prices dropped to as low as 10 cents per barrel and the Wyoming petroleum industry went into a lull until after the Depression (Wilkins 1958:19).

Due in part to its remote fields and lack of transportation facilities, Wyoming was a leader in technological development for the Rocky Mountain region. From 1900 to 1938 approximately 6,700 wells were drilled for oil and gas in Wyoming. Until 1927 virtually all drilling was done by cable tool rigs (Espach and Nichols 1941:4). Rotary equipment was first introduced in Wyoming in 1906 in the Garland field, in 1917 in the Big Muddy field, and in 1918 in the Rock River and Lance Creek fields. In all cases, the technology proved unsatisfactory. Refinements in rotary technology and technique improved the reliability of the method and it was being used with much greater frequency around 1927 to 1929 in the Big Muddy, Lost Soldier district, and Oregon Basin fields. The Oregon Basin was probably the first field successfully developed with rotary equipment. By 1934, nearly all wells were being drilled by the rotary method (Espach and Nichols 1941:4). Exploration techniques were being improved at the same time to the point that the Quealy Dome field was reported to be the first productive structure defined by geophysical means (seismographic survey) in the Rocky Mountain area (Espach and Nichols 1941:2).

The history of oil and gas development in Wyoming is not well documented. With the exception of works dealing with the Salt Creek field and the Teapot Dome scandal (see Beck 1929, Roberts 1956, Bille 1978, Knight 1896), the entire history consists of small reports in various journals and the recollections of people who were directly connected with the development of the industry. Thus the preceding can only serve to provide a brief overview of historical developments.

CHAPTER FOUR

SITE TYPES

The continued development of the oil and gas industry in the state of Wyoming has helped to provide energy, money, and jobs to the people of the state and assure a steady, if somewhat cyclical, pattern of growth. The development of new methods of secondary and tertiary recovery have helped to extend the production life of well locations and provide a slight stabilizing factor in the boom and bust cycle of an area by allowing production activity to taper off gradually. In the course of this progress, the physical evidence for the history of the industry was slowly being eradicated. As new locations were opened, or old locations revisited for secondary recovery, any physical remains from previous oil and gas activity at the location were quickly and efficiently "cleaned up." Archaeological surveys have only recently been instituted for energy development on federal land, but these have failed to resolve the problem as most archaeologists contracted to do the work have a strong prehistoric orientation and are not familiar with the material used to identify these sites. Those historic oil and gas sites that are spared from heavy modern development are often attacked from another direction. The large timbers associated with early cable tool rigs are highly prized by local ranchers and residents on the predominantly treeless plains. Scavenging has been a major contributor to the rapid destruction of all types of oil and gas sites.

In spite of the factors working against preservation, the massive scale of oil and gas development has assured that some of the sites have survived. Yet without proper evaluation and protection, this remnant is guaranteed to diminish rapidly. Examples of most, if not all, phases of exploration activity that have been mentioned in previous chapters can still be found in the field. These site types can be broken down into three general categories: hand-dug wells, drill sites, and support facilities. This chapter will examine each of these categories with a focus on the identification and evaluation of the sites in the field.

Hand-Dug Well Sites

With few exceptions, hand-dug wells were developed with a minimum expenditure of equipment and a maximum expenditure of manpower. Much of the equipment used could easily have been found on a well-equipped ranch of the period with very little that can be directly attributable to petroleum exploration activity. It is quite likely that some form of structure or long term campsite at or near the site of the well would contain similar materials and may give the site the appearance of an early homestead or ranchstead. Hand-dug wells were usually located near a known oil seep. Identifying this site type with oil seeps can be misleading, however, as many early seeps have dried up due to normal geological processes and modern drilling activity.

Hand-dug wells were usually cased while digging was underway to prevent the walls from caving in on the diggers and to preserve the integrity of the hole for later activities. Some wells were shallow enough that casing was not necessary. These wells would have deteriorated rapidly and may be unrecognizable today. Evidence of cased wells, especially the larger wells, are generally distorted by time but still recognizable. Removal of dirt from the hole while digging, and oil after completion, was usually accomplished by a windlass and bucket set-up. Brantly (1971:541) states that "it was customary on shallow wells to lower the pail with the crank handles and to brake the running bucket with hands held on the rotating drum". With deeper holes, the weight of the line and bucket necessitated the installation of a brake assembly.

Drill Sites

The use of drilling rigs and equipment has provided the largest percentage of early oil and gas remains. The three types of drill sites (springpole, cable tool, and rotary rig) dot the Wyoming landscape. Some areas were drilled so extensively that they have been described as being covered with a forest of derricks (for example, see Bille 1978:58).

Springpole Sites. Springpole wells were numerous due to the relative ease of set-up and the low cost of equipment. It was common practice for operators to file many claims in an area that might be expected to produce. The Placer Mining Act of 1920 and earlier laws required a minimum of $100 assessment work on each claim. A single team of men with a springpole rig could do the required work on a large number of claims in a short period of time. This allowed many low-budget operations to survive for a long time in the highly competitive business. A major drawback to this type of drilling apparatus was that it could only be used for very shallow holes and it did not perform well in soft rocks and sand. Although it was not uncommon for drillers to run out of money prior to reaching oil sands, the mobility of the apparatus made it possible to put down eight to ten shallow holes per day. This greatly increased the chance of hitting a shallow deposit. There are seldom any physical remains of the drilling rig found in the field due to the fact that few materials were required to construct the rig and these were easily portable.

Tool Hearth Sites. A component of springpole sites that is also found with cable tool sites as well as in isolation is the tool hearth. The tool hearth was used in the sharpening and resharpening of the drill bits after they had been dulled by the continuous pounding in the drill hole. The bit would be heated and resharpened by a special crew whose members were called "toolies." Firebrick was the preferred material to withstand the intense heat generated in the process. Some companies could not afford sufficient firebrick for their hearths and were forced to use regular brick or a mixture of both. When lesser quality brick was used, the high firing temperatures caused the brick to break up or crack, necessitating frequent repair and/or replacement. The hearth was usually constructed to be approximately two feet by three feet in size and of variable height. When the ash began to accumulate, it was shoveled out and deposited to one side along with any broken brick and trash, forming one or more refuse piles.

Tool hearths are often found as part of drill sites or campsites (Figure 3). In areas of heavy drilling activity a centralized hearth site was sometimes constructed to service several drilling rigs at one time. In this case, the hearth may appear to be completely isolated from other oil and gas sites. Site 48CR1679 provides a good example of an isolated hearth site. The site consists of a firebrick hearth approximately three feet by three feet enclosing a small mound of ash, coal, nails and metal fragments. The open (west) end of the hearth is in a wide area of scattered ash, coal, nails, firebrick, metal fragments, and several asbestos rings. A light scatter of two by four planking, tin cans, and four-inch diameter asbestos rings are located along an existing two track trail approximately ninety feet to the east. The extremely sparse debris indicates that the campsite or living areas were constructed in another location. Several abandoned drillholes in the immediate area indicate that this hearth may have serviced as many as five wells.

Cable Tool Rig Sites. Cable tool sites were once extremely common but their remains are becoming very rare. These remains are among the easiest to identify if certain materials are present. The standard cable tool hoisting equipment had been standardized in design and layout by 1880 and remained basically unchanged for almost sixty years (Figure 4). The Standard Cable Tool Rig was the mainstay of the industry until around 1917 when rotary rigs were becoming popular. In 1884, the Oil Well Supply Company

Figure 3. Tool Hearth Associated with 48CR2143

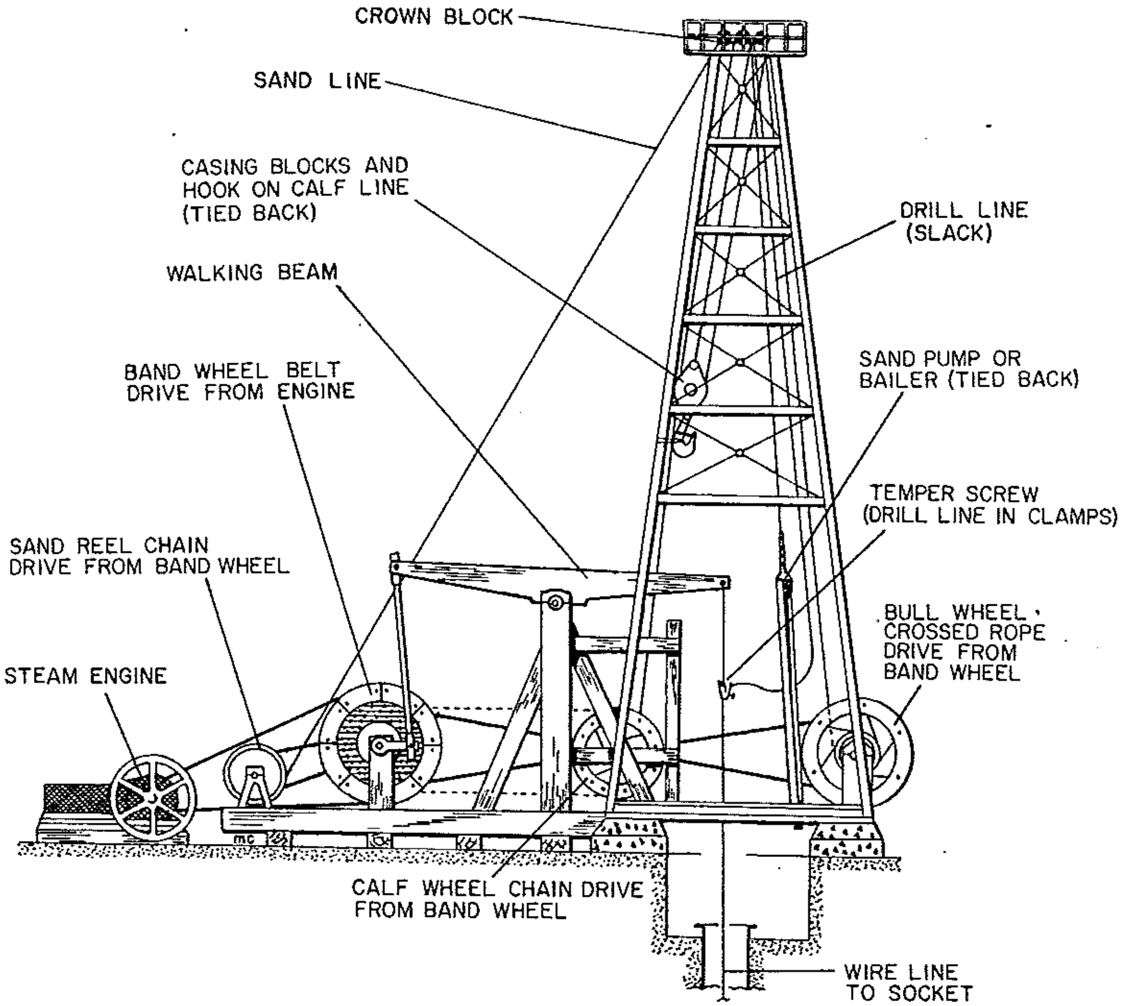

Figure 4. Standard Cable Tool Rig of 1900

of Pittsburgh, Pennsylvania, published the first major catalog which included complete descriptions of the various types of oil field equipment. Its section on above ground rig components provides a complete and accurate description of the standard cable tool rig including measurements of most of the major components. This section of the catalog is extremely useful in identifying and describing cable tool components and as such is reproduced as Appendix Three.

The standard cable tool rig consisted of a series of wheels, hoists, and pulleys utilized to raise and lower the drill string and associated tools. Two wheels called bull wheels were connected by a shaft forming a spool to handle the drill cable in hoisting and lowering the drill string. One bull wheel was connected to the brake and called the brake rim while the other was connected to the tug pulley by the bull rope and was called the tug rim. Bull wheels of 1880 had been standardized, probably for some years, at seven and one half feet in diameter on a wooden shaft thirteen feet long and thirteen and one half inches in diameter (Brantly 1971:564, Figures 5 and 6). Power was generally provided by a steam powered engine and boiler attached to the band wheel. Fuel for the engine varied based on local availability but ranged from wood and coal to fuel oil. The band wheel was the intermediate power transmitter between the steam engine and the rest of the rig (Figure 7). It consisted of a wheel nine feet in diameter with an eight inch rim, or face, constructed from shop-cut pieces. The shaft was twelve feet long and ten and one half inches in diameter (Brantly 1971:564. The band wheel received

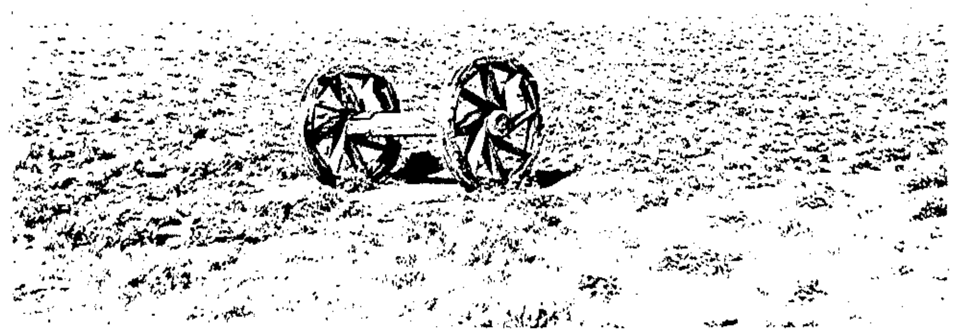

Figure 5. Isolated Bull Wheels

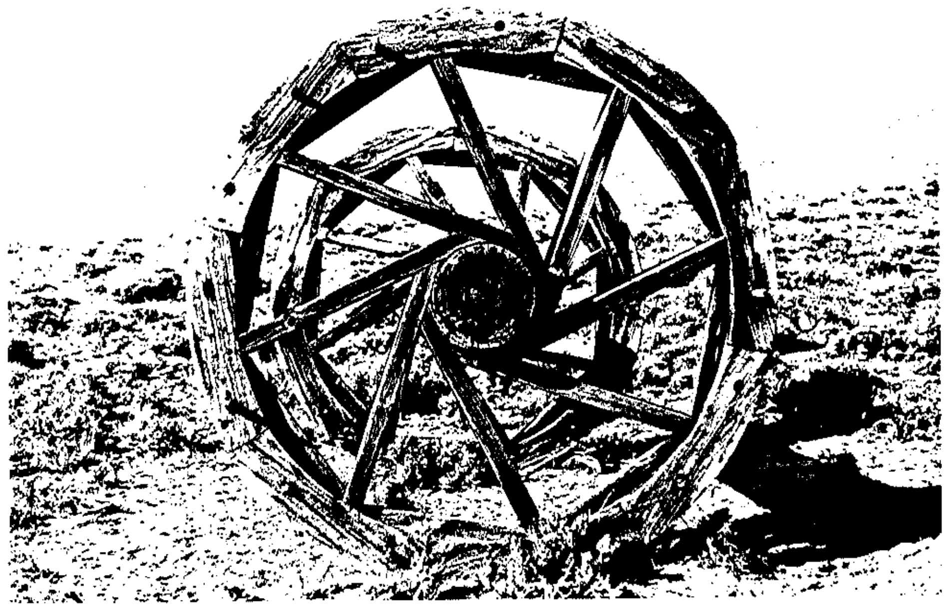

Figure 6. Side View of Bull Wheel

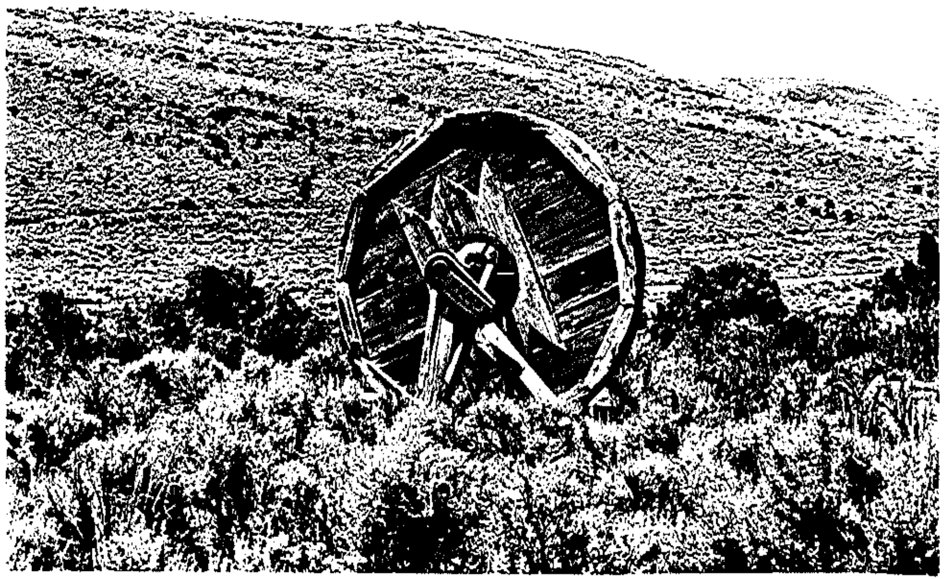

Figure 7. Band Wheel

power from the engine by a belt and transmitted power to the hoists by means of a rope and to the walking beam by way of a crank and connecting rod or pitman (Brantly 1971:550). A small wheel, or tug pulley, was bolted to the opposite side of the band wheel. Band wheels of 1880 carried only one tug pulley. By 1890 an extra bull wheel, called a calf wheel, had been developed which necessitated tug pulleys on both sides of the band wheel. The calf wheel was developed to improve the rigs' performance when drilling in soft or "cavey" ground in reasonably deep wells. The calf wheel decreased in use in the 1920's as by the 1930's practically no cable tool rigs were operated in soft formation areas, having been replaced by the more efficient rotary rigs (Brantly 1971:565-566). A rope (the bull rope) was run from one tug pulley to the bull wheels and an additional rope was run to the calf wheel (post 1890). The bailer and fishing tools were attached to another wheel called a sand reel or sand pump reel. As the weight handled by this wheel was much lighter, the wheel was smaller than the bull wheels and derived its power directly from the band wheel.

Cable tool drill sites can be found in many areas of Wyoming in various states of decomposition. Several nearly complete sites of this type are known, including one which has been preserved by the Amoco Oil Company in the Salt Creek Field near the town of Midwest (Figure 8). One fairly typical example of what the field archaeologist or historian has previously written off as recent historic trash can be illustrated by site number 48CR4167. This site consists of a fairly dense scatter of timbers associated

Figure 8. Modern Pump and Early Cable Tool Rig

with a derrick and drilling rig. No habitation or other occupation debris was noted other than numerous nails and a 1932 Wyoming license plate. The location and orientation of the drilling rig could be identified by the fact that, although some of the mud sills had been moved, most remained in situ. All of the large wheels and hoists and most of the rig components had been removed. The walking beam and assorted support timbers were all that remained (Figure 9).

Rotary and Combination Rig Sites. The wheels, pulleys, and hoists of the cable tool rig described in the preceding pages tend to be some of the more conspicuous and common items found on this type of site and it is important that a correct identification be made in the field. The presence or absence of many of these items can be considered to be important indicators of the type of rig under consideration. Cable tool rigs are readily distinguishable from the rotary rigs commonly used today. The earliest rotary rigs were actually a cross between the two types as the rotary table was often attached to a cable tool set-up utilizing the same series of pulleys and hoists to handle the loads. The power was delivered to the rotary table via the band wheel. By the time rotary rigs were being used in Wyoming, however, they had already developed a specialized system of hoists and draw works totally distinct from the cable tool rigs. Combination rigs, which came equipped with both cable tool and rotary equipment designed to overcome the limitations of each type by providing dual capability, saw only limited use in Wyoming.

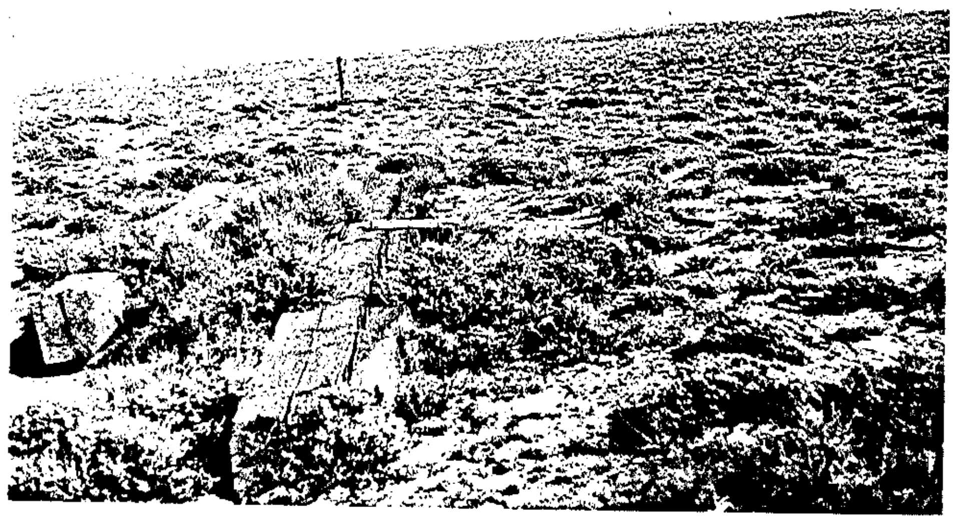

Figure 9. Abandoned Walking Beam and Timber

Continued improvement in rotary drilling equipment eliminated the advantages of the combination rigs and they were rapidly phased out.

Rotary rigs were undergoing rapid development at this time and there was a tremendous amount of variability in the type and style of equipment being used in the field. It would be pointless to attempt to describe the multiple variations of rotary rigs being used in the oil fields. For further information on the development of this equipment, the reader is referred to Brantly (1971) for an excellent technical discussion. One point regarding this type of equipment deserves mention, however. Rotary rig equipment was becoming specialized to the point that it could no longer be fabricated by "rig builders" in the field. Companies were spending relatively large amounts to purchase and transport this equipment to the drill site in contrast to cable tool rigs, whose builders could often acquire the needed timbers for most of the rig from locations a great deal closer and at a lower cost. This has a direct bearing on what will be located and observed in the field. Cable tool rig sites will often have some of the major rig components remaining whereas rotary rig sites may have virtually no remains or at most some isolated timbers from the derrick and mud sills because rotary rig equipment was moved from one site to another. With the increasing use of durable steel derricks in the early 1900's, even these remains may be absent.

<u>Portable Rig Sites.</u> The difficulty of access to many areas of Wyoming meant that it became very expensive and sometimes nearly impossible to move the large, heavy equipment into the fields. In some of these areas small, portable drilling rigs were used extensively for shallow wells. Most of these were cable tool rigs but a few of the later rigs were equipped with rotary apparatus. Several varieties of these portable rigs were popular in Wyoming, including varieties of Star rigs and Parkinson rigs. The majority of the portable rigs were set up much like the larger standard rigs and included a walking beam, band wheel, sand reel, bull wheels and (sometimes) a calf wheel (Figure 10). The entire assembly was mounted on wheels or skids and was either self-propelled or towed. Due to the large variety of self-propelled machinery and hardware the reader is referred to Brantly's <u>History of Oil Well Drilling</u> (1971:Chapters 13 and 30) for a pictorial comparison.

Support Facilities

With the expansion of drilling activity throughout the state, numerous support facilities were established, ranging from small, temporary campsites to company towns and from small isolated refineries and processing plants to massive refinery complexes such as those located around Casper. A great deal can be learned from them about life in the early oil patch as well as about life in the region during that period of time. Studies of the

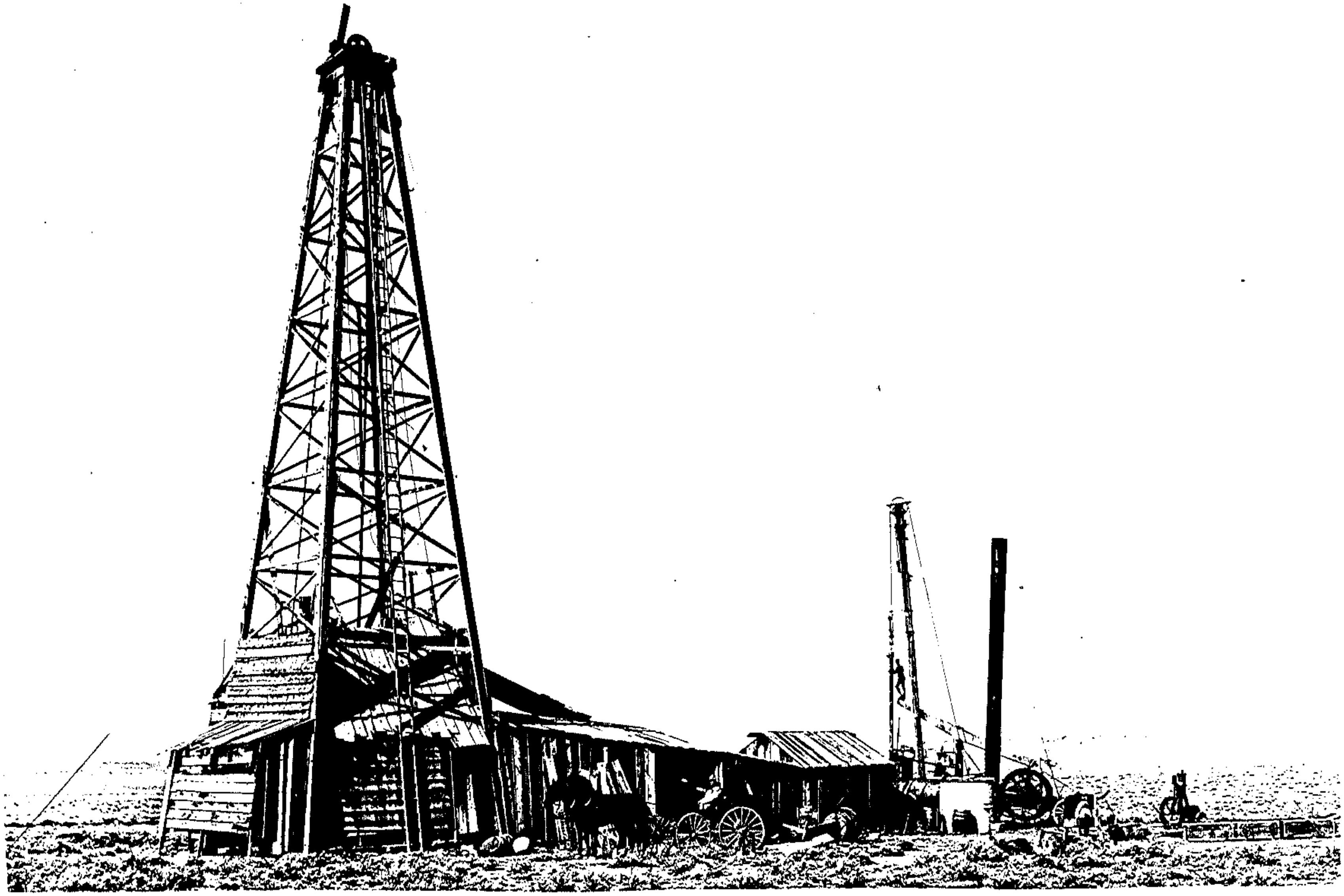

Figure 10. Cable Tool Rig and Portable Rig (1903)

material remains in these sites can provide information on the economic status of oil field workers and the transportation system that provided them with material goods. It can provide us with an idea of how people lived in a time of high stress and rapid change. For these reasons it is very important that adequate studies be conducted on these sites. The development and expansion of these facilities incorporated many new innovations that were forced on the builders and operators due to the problems of transportation and availability.

Short Term Camps. Few short term campsites have been recorded, but there seems to be a definite pattern in the location of the campsites relative to the surrounding explorations. It appears that a centralized location was chosen for the site and that drill sites were located at the campsite and in the general area in what can be called a satellite pattern. This pattern has been observed at many of the exploratory areas that have been surveyed. Once a producing field had been established one or more company camps or semi-permanent towns were established.

One example of a short term camp was recorded in 1981 as 48CR2143 in Carbon County. Documentation examined in the Lands Records at the Carbon County Courthouse in Rawlins, Wyoming, indicated that the site was occupied in the early 1920's by the Producers and Refiners Corporation. Records indicate that a gas well was brought in at this location on October 14, 1924. This site is a fairly good example of an oil field camp in that much of the activity conducted at this type of site is represented here. The historic sites analysis conducted on the site was one of the first attempted for an oil and gas camp in Wyoming (Gilbert et al. 1981) and as such has its strong and weak points. It was able to document that there were two distinct areas of activity on the site, one a habitation area and the other a work area. The habitation area consisted of two apparent dumps and numerous smaller concentrations. These smaller concentrations consisted primarily of small piles of coal and cinders associated with scatters of tin cans, stove parts, bottle fragments, and numerous other artifacts associated with the daily living habits of the individuals (i.e. wash basins, toothbrushes, coffee pots, etc.) The number and size of these concentrations may have given an indication as to the approximate number of the residents of this camp but unfortunately this information was not recorded at the time. The workers probably lived in walled tents as the only real structural remain in this area consists of a three meter by two meter depression that contains partially buried planking and posts, probably the remains of the camp privy. It is located near a pile of coal and cinders that indicate that the camp stoves and drilling equipment were probably coal fired.

The area to the north of an old trail, which nearly cuts the site in half, is characterized by a high density of fire-brick, cinders, pipe, plumbing parts, tools and planking. There are several areas of concentration, which can be identified with different work activities that center around the drill site. Remains of the drilling rig are scattered around the area. These parts include derrick timbers, the walking beam, assorted timbers and beams, and what is possibly a very deteriorated bull wheel section. Some of the mud sills and the eight foot by eight-foot by three-foot deep cased drill hole area are intact (Figure 11). At least two other concentrations appear to be hearth locations where the dulled drill bits were resharpened. These concentrations consisted of firebrick from the Golden Company of Colorado, coal, ash, cinders and numerous grindstone fragments, including one large conical grindstone fragment (see Figure 3).

Several other areas of the site deserve mention. One concentration located near the drill rig appears to be the remains of a tool shed which had burned down (Figure 12). The heat of the fire had been so intense that some of the bottles and tools were partially melted and deformed. Another area of the site contained a low mound of fine grey bentonite, which was probably used in the drilling process. Bentonite is a fine clay that can be mined in many areas of Wyoming and is prized for its lubricating properties. A drill hole filled with water tended to decrease the weight of the drill bit and line on the hoists, and clay particles suspended in the water permeated porous formations

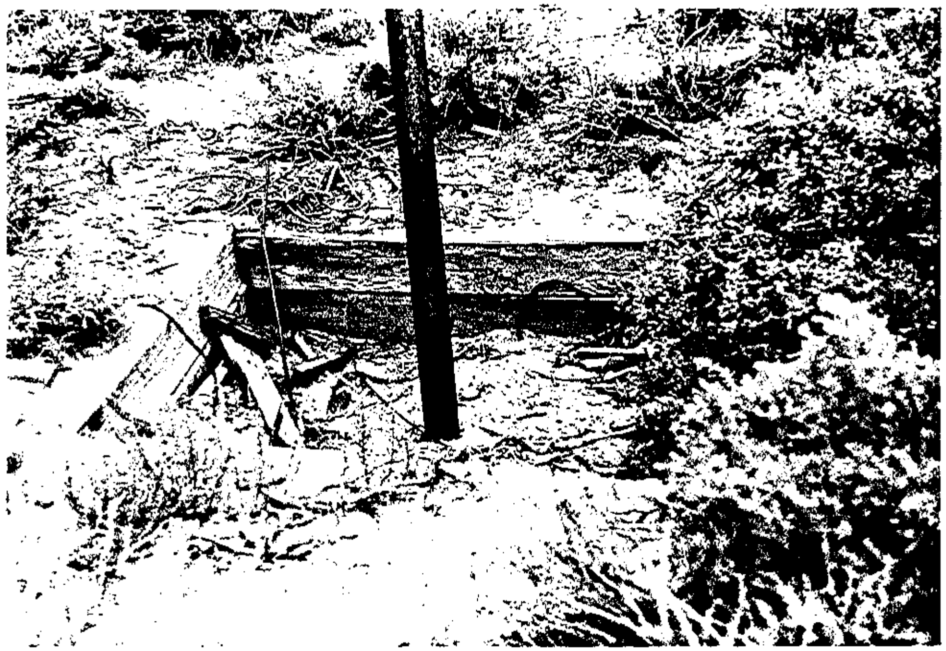

Figure 11. Drill Hole at 48CR2143

Figure 12. Remains of Burned Tool Shed

tending to seal off the walls of the hole and help stabilize it. A small retaining dam had been built across a shallow intermittent drainage just to the west of the clay mound. This location is probably where the bentonite was mixed with water before it was pumped into the drill hole.

There are numerous indications that oil was either discovered or handled at this location. Small nodules of hardened crude oil and pebbles covered on one side with baked crude oil would seem to support this assumption.

Storage Sites. Once the oil or gas was discovered at any exploration site such as this, the problem became what to do with it. There was an immediate problem of temporary storage and an additional problem of transportation to refineries and other markets. Pipelines came relatively late to most oil fields and attempts were made to store oil by damming up large intermittent drainage channels or excavating large areas to create artificial lakes of oil (Figure 13). In some of the more developed fields wooden stave tanks were built to store some of the oil, but much of it ended up in the artificial lakes. The remains of some of these lakes are still highly visible in some areas of the state, particularly along US 287 and Wyo 789 in the Separation Flats area north of Rawlins and along old highway 87 in the Salt Creek Field. As can be guessed, these lakes created a tremendous fire hazard. Lightning strikes were a danger for all types of early storage facilities and some have been reported to have started fires which burned for weeks (Figure 14).

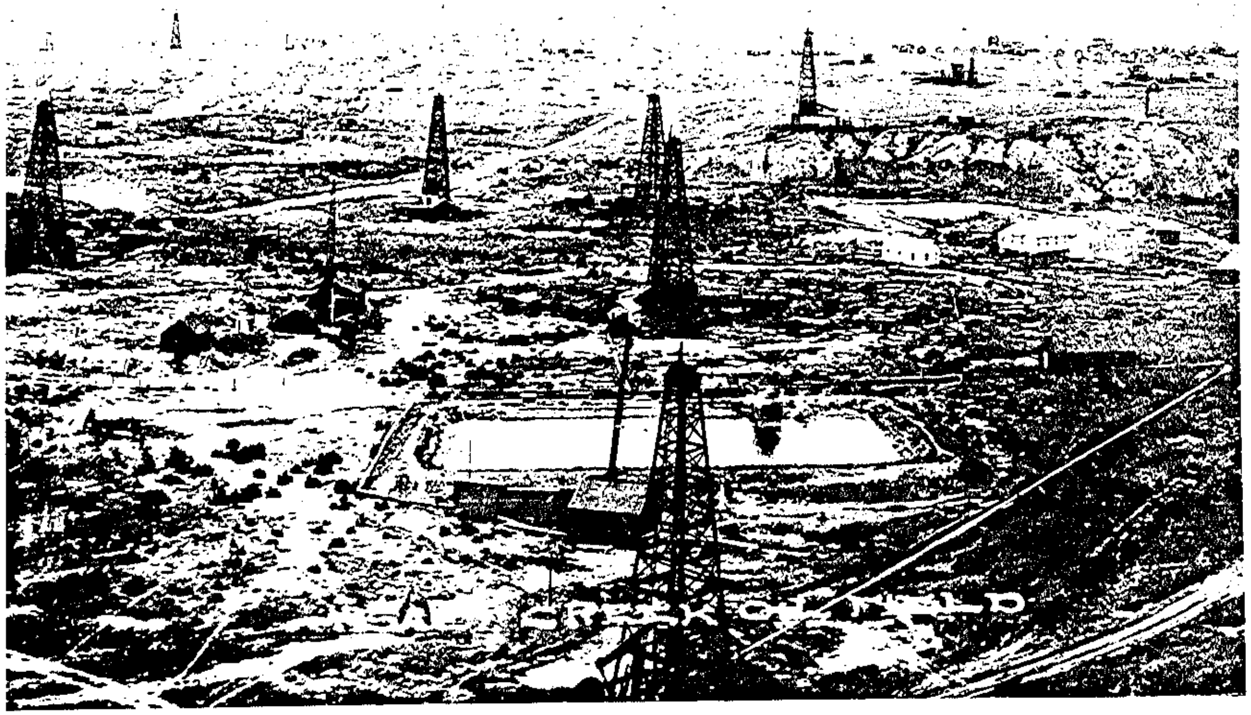

Figure 13. Oil Storage Lake at Salt Creek

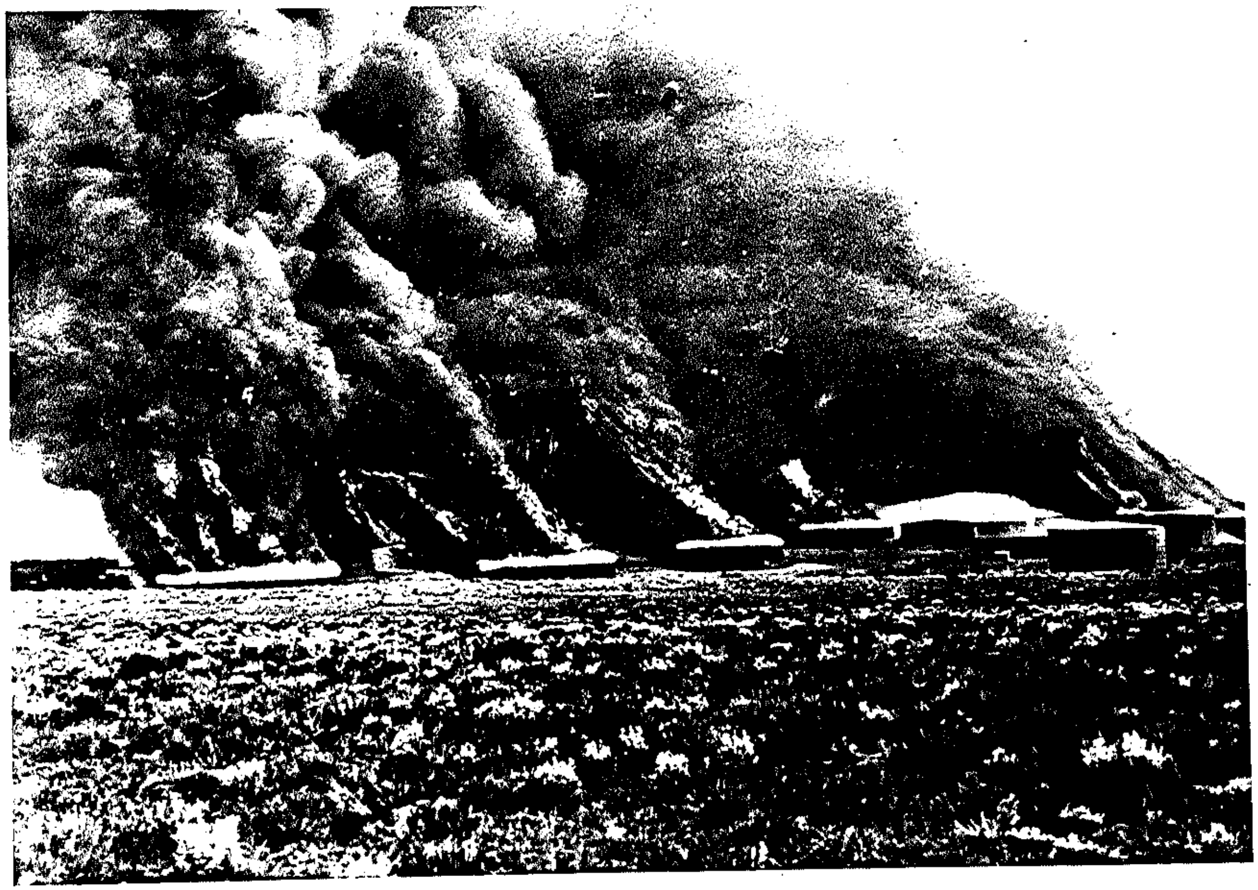

Figure 14. Oil Tank Fire near Casper

Processing Sites. The storage of natural gas proved to be an almost insurmountable problem in the early fields and many millions of cubic feet of gas were simply "blown to the wind" or allowed to escape into the atmosphere. When pipelines were constructed, small gasoline plants of various types were built in the fields and the resulting products were used either to power the pumps and drilling rigs in the field or were piped to various markets. Carbon black plants sprang up to utilize some of this gas. Carbon black is the residual material produced from the burning of unprocessed natural gas. The gas was burned under a concave dome and the residual buildup was scraped off and used as a black pigment.

In some cases small refineries were constructed in the field to help pay for drilling activities by selling petroleum products to local ranchers and towns. This was the case for a small refinery in Uinta County, which provides an excellent example of what may be encountered in this type of site (Figure 15):

Site 48UT837 is a well preserved multiactivity site consisting of a small refinery, a cable tool drill site, a railroad loading area, and an abandoned portable drilling rig. The site is located along a seldom used stretch of highway and has suffered a considerable amount of vandalism in the form of scavenging for wood. Most of the timbers associated with the drilling rig have been removed (some apparently very recently). The large wooden wheels have been removed from the portable drilling rig and the rig was propped up on fresh cut (1981) strips of wood (Figure 16). The refinery itself has been spared a large degree of vandalism

Figure 15. Band Wheel and Refinery

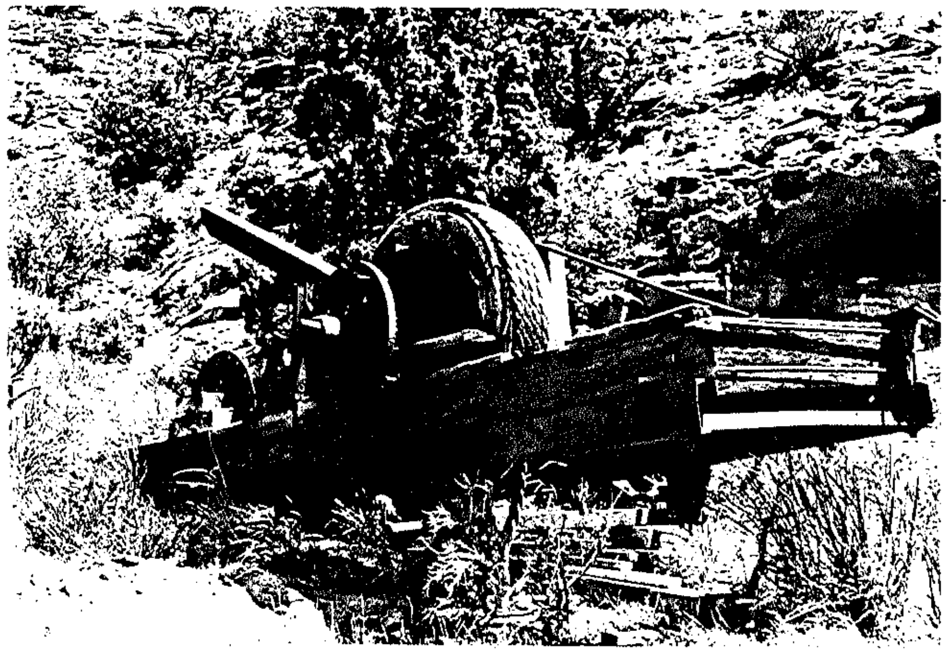

Figure 16. Portable Drill Rig

because most of the structure was constructed of corrugated steel (Figure 17). Much of the interior equipment had apparently been removed at the time of abandonment although the large boiler and furnace remain. The refinery was constructed in 1907 and put into operation that same year. The oil refined here was sold locally to finance drilling operations in the area and used domestically in the town of Spring Valley. The refinery was operated intermittently for many years. The railroad tracks and loading area were constructed around 1909 and some of the oil was shipped to Salt Lake City for refining. The refinery was finally shut down in the mid-1930's.

The structural remains of the refinery are in fairly good condition although the wind is beginning to take its toll on the roof. A channel has been cut into the sandstone running from the ridge top to the refinery. The purpose of this channel is unclear although it may have been used to transport oil from wells on top of the ridge or water for the boiler.

The portable drilling rig was parked behind the refinery and is very similar in design to the small Star drilling rigs constructed from 1900 to 1920. This unit appears to be an early version due to the fact that it is composed primarily of wood. After 1910 much of the chassis and equipment of this type of rig was being constructed of steel.

Very little remains of the drilling rig located just west of the refinery. The large band wheel with its attached rig irons is still mounted on its base and what appears to be a crown pulley is lying nearby (Figure 18). Little else was observed

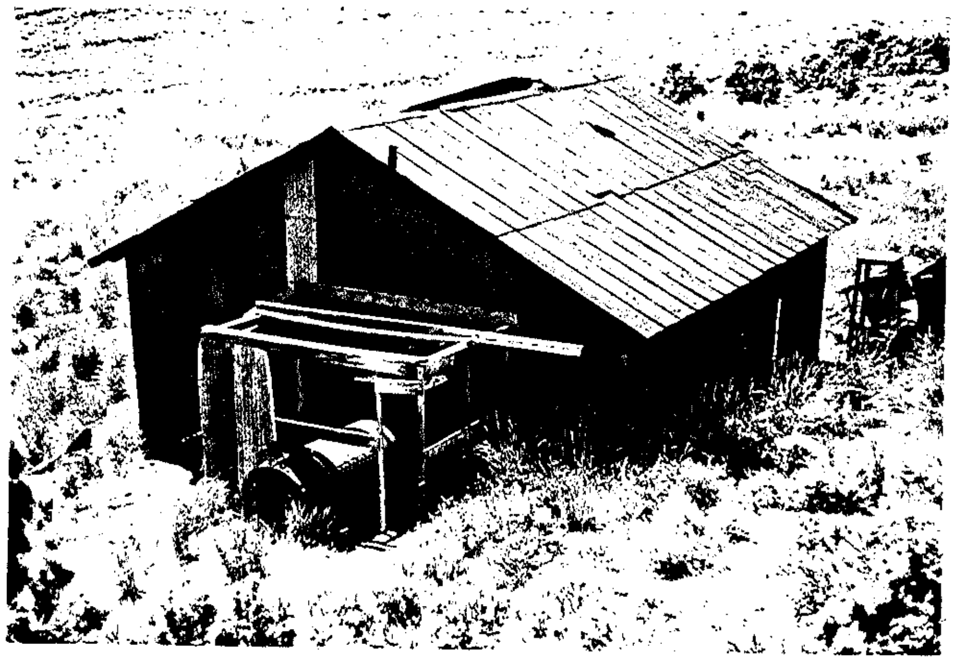

Figure 17. Refinery Building

Figure 18. Crown Block Assembly

other than scattered nails, glass, and wood fragments. This band wheel also served as the power distributor for a second drill rig located on top of the ridge (Figure 19). A heavy cable was observed running from the first location to the second. The J.E. Stimson collection of the Wyoming State Archives, Museums and Historical Department contains a photo of the second drill site taken in 1903 (Figure 20).

Nearly all of the examples given so far were originally recorded by an individual who had no real idea of just what he was looking at beyond that it was associated with oil and gas or mining activity. As a result, the site records required a great deal of interpretation prior to being summarized here. The translation has helped to underscore the need for the recorder to have some familiarity with the range of materials which may be encountered. The knowledge of this material is not easy to come by, unfortunately, and it would require a great deal of effort on the part of the archaeologist or historian to acquire. With the current state of knowledge, the primary requirement in the recording of oil and gas sites is the complete and accurate description of the materials observed, including the shapes of the major timbers and "wheels," or hoists. This would enable someone familiar with the site category to reconstruct some of the available data. A good written description should allow the reader to determine what type of site is being described, the nature, type and areal extent of the activity conducted on the site, and the approximate time period involved. In some cases the question of dating cannot be resolved without

Figure 19. Drill Rig Remains Near Spring Valley, Wyo.

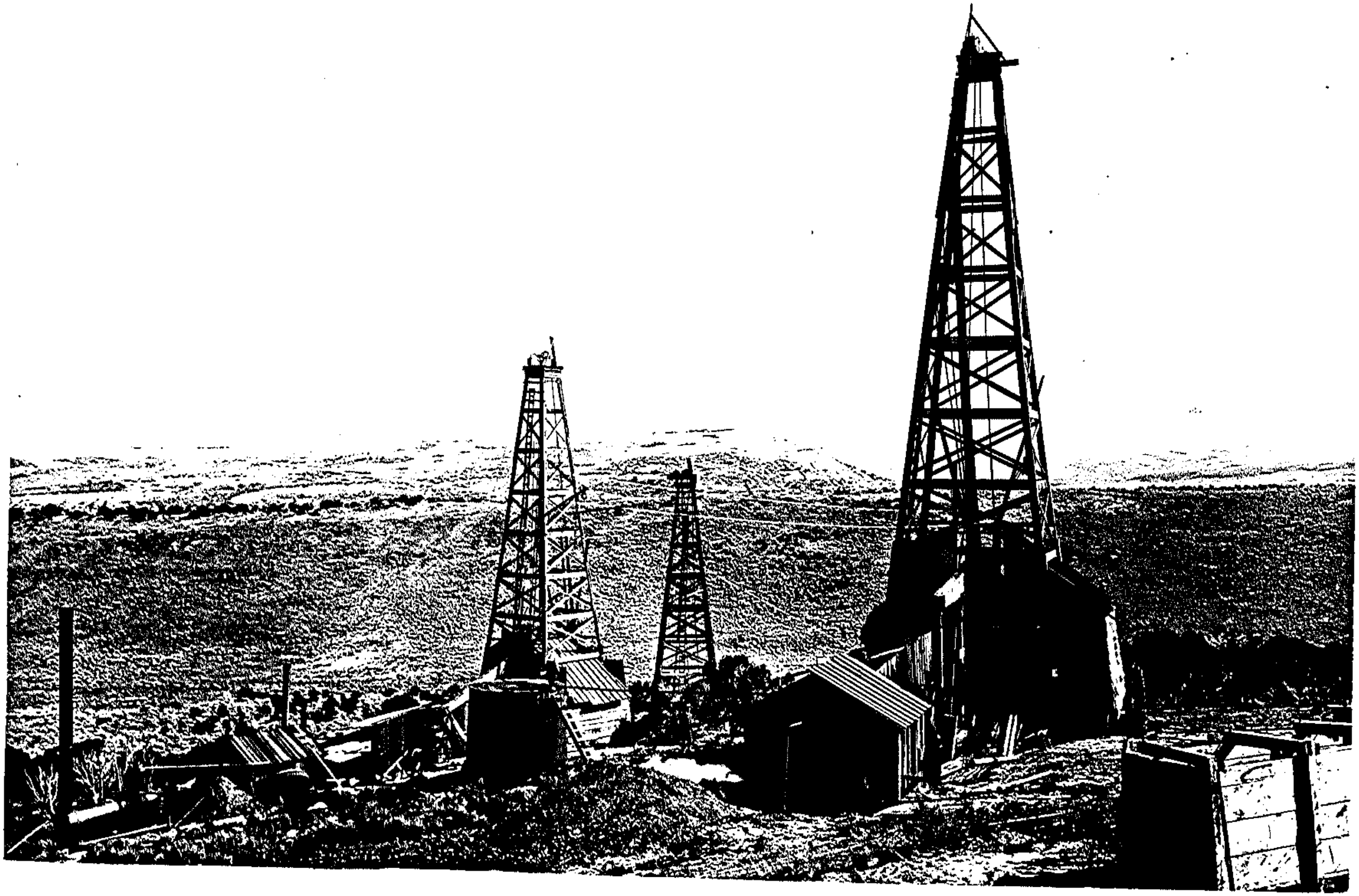

Figure 20. Spring Valley Oil Field (1903)

conducting a literature or title search, but there is usually sufficient common material (i.e., bottle fragments, tin cans, etc.) on the site to establish a general time estimation. The following chapter will provide suggested guidelines for the evaluation of historic oil and gas sites in Wyoming. These guidelines will help to summarize some of the material presented in this chapter within the framework of the identification and the evaluation of sites found in the field.

CHAPTER FIVE

FIELD IDENTIFICATION AND EVALUATION

The proper identification of oil and gas sites in the field requires some general knowledge of the site category. This knowledge is lacking in most field personnel primarily due to the fact that this site category is not normally included in their training. With this in mind, this chapter will present some suggested guidelines to follow until a more detailed knowledge of these sites is developed.

The preparation of guidelines of any type is, of necessity, done with certain objectives in mind. The primary purpose of most guidelines is to assure that some form of continuity is achieved in the treatment and handling of a particular subject. It is commonly assumed that the person receiving the guidelines has a basic knowledge of the subject. As noted above, this assumption is usually not valid when dealing with petroleum industry sites. Thus these sites present a special problem and any guidelines must be oriented toward focusing attention on the types of information necessary to properly record and initially evaluate them. In other words, the appropriate treatment of the resource and the education of field personnel must be accomplished at the same time through the issuance of a series of guidelines that begin with instructions for the identification of the resource and develop in stages to the evaluation of significance and National Register eligibility. It is also important that sufficient information be provided to allow interested persons to find additional data and information with which to educate themselves further.

It is very difficult to evaluate these sites without some appreciation for the nature of the resource and its impact on surrounding communities. Some sources of information on individual fields and areas include Wyoming Geological Association Guidebooks, U.S.G.S Bulletins, and U.S. Bureau of Mines Reports. These publications often include short histories and location maps of early wells.

One segment of the historical record of the oil and gas industry is disappearing almost as fast as the archaeological materials. This segment consists of the collective memories of those individuals who worked in, or were connected with, the early oil patch. Here is a tremendous source of information on virtually every phase of activity in the state that has been almost completely ignored until very recently. Very little is being done to accumulate the memories and recollections of these people. One project is currently underway, conducted by the staff of the Fort Casper Museum of Casper, Wyoming, who are attempting to accumulate historical documentation and participants' statements for the industry in central Wyoming for the purpose of establishing a travelling exhibit. They also wish to establish a depository for such information in the area. It is a first step, but much more needs to be done. Other depositories of photographs and similar materials are located in the University of Wyoming Petroleum History Center in Laramie, the Wyoming State

Archives, and the Colorado State Archives. These depositories are there to provide as much help as possible for those that ask. The real problem is generating interest in, and an awareness of, the resource base. All the depositories in the world would not provide any protection to the resource if people were not aware of the problem.

Identification

As detailed in the previous chapter, there are several general categories of oil and gas sites which can be encountered in the field.

1. Hand-dug wells

Hand-dug wells provide some of the earliest remains of oil and gas exploration in Wyoming. They are most commonly seen as open pits of variable size, occasionally lined with planking. These are almost always located near oil springs or seeps. This type of site is known to exist in the vicinity of Moorcroft, Casper, Spring Valley-Evanston, and several points in the Big Horn Basin. They have been associated with Jim Bridger, Kit Carson, Jim Baker, Brigham Young, Judge Carter, and Cy Iba. This type of well is known to have been used from the mid-1800's to the early 1900's. As the artifactual materials associated with this type of site are generally very sparse, it is usually necessary to identify and evaluate the site through historical documentation and geological reports. These sites should generally be considered not eligible unless they are associated with a historic event or person and have sufficient integrity and artifacts to provide a good example of the technological developments of the time. Integrity here can be defined as the degree to which the physical dimensions and configuration can be determined from visual inspection. A hand dug well site with excellent integrity could consist of a plank-lined pit with ladder, winch, buckets and some wood-stave storage tanks.

2. Drill Sites

There are several varieties of drill sites that can be found in Wyoming. As described in the previous chapter, these are springpole, cable tool and rotary rig drill sites. In recording a drill site location, it is important to record the size, shape, and number of any timbers and include a complete list of artifact types represented. Sites that represent a fairly complete specimen of the drilling rig should be preserved for their research and recreational value. In general, most drill sites can be considered to be not eligible unless they are directly connected to an important event in the development of the oil and gas industry in Wyoming. Examples of this could include the discovery well of a major oil or gas field, the location of the first successful rotary drilling in Wyoming, and the like.

3. Field Camps

The field camp probably provides the best opportunity to learn about life in the early oil patch from physical remains. Such camps are often directly associated with one or more drill sites and some camps can be divided into work areas and living areas. Field camps were often constructed of corrugated steel buildings and/or tents so that it is rare to have standing structures associated with any but the longer term area camps, which often took the form of "company towns." An extensive field camp can provide important data on settlement and work patterns, exploration strategies, economic distribution, etc. This site type should, therefore, be evaluated in terms of research potential, level of disturbance (if any), and the importance of the field in which it is located.

4. Other Facilities

The oil and gas industry provided fuel and incentive for the development of numerous related facilities including refineries, storage facilities, carbon black plants, etc. These should be treated as any other historic site with special attention given to the integrity of the facility, the importance of the facility to the area and the importance of the field to the development of the state.

5. National Register Districts

An oil or gas field with numerous early development sites is a logical area for nomination as a district. It is important to remember that a district nomination should be written with the current usage of the area in mind. An active field can be nominated as the current use is not in conflict with the historical use which made the field important in the first place. It is simply a matter of identifying historically sensitive areas and isolating them for preservation within the district boundaries. By keeping in mind the restrictions and constraints within which the oil and gas companies must work and by advising and consulting with them as the project develops, you may find that they become your strongest ally in the preservation and protection of the historical resource. Abandoned fields and exploration areas, however, can be treated in much the same way as any other potential National Register District.

Evaluation

In order to properly evaluate an oil and gas site, a chain of title search must be made. The chain of title search will enable the recorder to identify who drilled the well and when. In some cases the deeds or leases will indicate what type of equipment and/or additional structures were used on-site. It is important to look for any entries which would indicate a tax or legal action. The description of the action in these cases will often include an inventory of the equipment involved. The literature search can provide important historical documentation on the well location and the field it is located in (if any). Nearly all of the existing or abandoned fields in the state have been covered by United States Geological Survey Bulletins or Wyoming Geological Association publications. In most cases, these publications contain a short historical overview and maps locating well sites in addition to roads and other facilities. These sources can usually provide the date necessary to properly evaluate the historical importance of a particular location. The evaluation of the overall significance of the sites is slightly more difficult. It is easy to see that a historic oil and gas site would be considered important based on its historical contribution to the development of the industry and the state. In this case, discovery wells could be considered to be generally more important than later wells in the same field due to the fact that it was the discovery well which provided the impetus for further drilling in that area. A discovery well is the first well which produces oil or gas in a quantity that indicates a potential for commercial profit. The discovery well is often not the first well drilled in an area nor is it often the first well to show oil or gas. Once the commercial potential of an area is established, the green light is flashed for investment capital, jobs, and people to move in and develop that area. This provides a tremendous boost to the economic development of an area. The impact of future wells is generally less, but of course there are always exceptions. The point to be made is that one must be aware of the impact that the site in question had, or may have had, on the local area (and the state in general) in order to properly evaluate its significance.

As with any archaeological site, a major factor in evaluating the significance of an oil and gas site is the extent to which that site can provide data that is important to existing research questions and designs. Due to the fact that little attention has been paid to this site category, few avenues of research have been explored. The following chapter will attempt to present some potential research questions that can be applied to these sites and to outline the development of a research design.

CHAPTER SIX

RESEARCH QUESTIONS AND DESIGN

The growth of the oil and gas industry has left its mark on Wyoming's landscape. Drill locations, camps, towns and other facilities (past and present) are found throughout the state, providing a vivid record of a rapidly changing segment of American history. In spite of, and partially because of, the massive amount of exploration and development activity, this record is rapidly disappearing. The oil and gas industry in Wyoming is 100 years old and the exploitation of the resource itself is much older than that. Due to a particular type of ethnocentrism which is based on technological development, we refuse to recognize that a particular resource utilized today may have been utilized in different ways by different people at different times. This technological ethnocentrism, or technocentrism, has proven to be a major barrier to the study and documentation of the early utilization of petroleum by the Indians, early white trappers, settlers, and the like. People have an underlying assumption that the dependence on and importance of petroleum came only with mechanization and, as such, have no idea of the importance of this natural resource to people before its development as a motor fuel. This orientation has prevented researchers from even knowing what questions to ask. As a result there is very little available information on this aspect of the period.

This problem persists somewhat into the early development period of Wyoming's oil and gas industry. Very little historical or archaeological documentation exists for any aspect of the early industry in the state. What historical material is available is generally located in publications oriented solely towards the geologist or petroleum engineer. This general lack of available data has made the development of organized research questions or designs extremely difficult for those few who are even aware that this site category exists. The recording and analysis of these sites has therefore been relegated to the simplest levels of data gathering.

It is possible, however, to outline certain research questions based on the available data and the areas of potential research indicated by the sites already recorded. This should be considered to be very tentative and should be reevaluated as further data becomes available. The development of valid research designs needs to be based on a series of research questions or goals which develop from the available information. The research design is simply a mechanism to achieve these goals. As summarized in Tamez, et al. (1981:36):

> All research designs, archaeological or other, have to contain certain features or components:
>
> 1. The background of previous research, and the implications of that research to the investigation proposed,
>
> 2. The theoretical basis of the proposed research,
>
> 3. The problems to be investigated, including specific hypotheses (as appropriate) and test implications,
>
> 4. Data collection techniques, and

5. Analytical strategies and units (Raab 1977:168-170).

Research questions can be addressed on several different levels. These levels and a possible line of development for research designs are outlined by Rondeau (1981), who presents what he calls four "levels" of research questions which can be applied to the development of research designs: data-focused, site-oriented, regional, and processual. This outline and research design will be adapted to the oil and gas data base and presented in this chapter.

The data-focused level concerns the data within the site itself. It involves the information that can be gained from the artifactual material and features found on the site, how they relate to each other and to the site context as a whole. This level addresses such questions as: What can be learned about oil and gas exploration, life in the early oil field, etc., through a study of the physical remains?

The site-oriented level takes the information gained on the data-focused level and attempts to develop an understanding of the site as a whole as it relates to oil and gas development at the time. This level deals with the site as an individual unit and examines the data derived from the artifactual material in terms of external influences or determinants. The artifactual data from campsites, company towns, etc., when viewed as an integrated unit can provide important insights into trade and distribution patterns, technological innovation, and development as well as providing answers to numerous other questions that can be narrowed down to a site specific emphasis.

The regional level combines the data base from a number of sites within a certain specified area based on natural or artificial boundaries. In many cases, questions addressed on the site-oriented level can also be addressed on the regional level with expanded emphasis. This level is the point at which real synthesis begins to occur. Sites within a particular area can be compared and contrasted with each other in an attempt to begin to understand the processes that are acting on, and within, a region at any particular time and how these processes affect the sites in a region through time. The regional level should be used to consider the effects of the sites on other variables within the region. The effect of the boom and bust cycle generated by oil and gas development on the settlement patterns in the area and the effect of long term oil and gas development on the socioeconomic development of an area through time are examples of quesitons that can be addressed at this level in addition to questions of technological development and utilization of the environment. An example of a regional level research design has been developed by Sonia Tamez, et al. (1981) for historic railroad logging operations in California. This research design is a good example of what may be developed for the oil and gas industry once we have accumulated sufficient data. It divides the study of logging operations into four main "research domains" within which are developed specific research objectives. The four research domains are: Environment, Economics, Technology, and Social/cultural dynamics. After developing the research objectives, the authors provide a three-part outline of their implementation plan for the design. Many of the techniques and research categories used in their study can be directly applied to studies of the oil and gas industry. In spite of the lack of concern in Wyoming for the archaeology of the oil and gas industry, sufficient data exists to begin formulating research designs of a very rudimentary nature which, in turn, can be developed into designs similar to that of Tamez et al.

The final level of research questions is definitely the most abstract. Yet the processual level provides the potential for contributing to the greater understanding of the historical development of the nation as a whole and, to take this one step further, to begin to make generalizations concerning the behavioral nature of man and culture change (Rondeau 1981:33). It is in this sense that a study of the historic oil and gas industry can provide a lasting contribution. The stimulus provided by a ready market and the industry's "get rich quick" potential created a unique lifestyle that persisted with great intensity for a relatively short period of time before moving on to new discoveries in other areas leaving behind vastly changed communities.

The level of research questions addressed in the research design needs to be based on the amount of information available on the site or related sites. Obviously several levels can be applied to a site at the same time, especially when a great deal is known about that particular site. The progression from data-focused to processual should be addressed at some time during the course of study of the sites, but if data recovery and analysis have already been conducted then it may be more appropriate to address the site-oriented or regional levels. In this case, the results from data-focused analysis can be summarized and directions for further questions can be indicated while dealing primarily with site-oriented analysis. Once the primary level of research questions is identified, the research design can be developed.

Numerous approaches have been utilized for the development of research designs, but the status of the research design appears to have suffered tremendously in recent years. Part of the problem may be owing to the fact that contract history and archaeology have been forced into numerous small scale projects that are sometimes quite isolated from each other. These projects are often conducted under severe time constraints. This "fast and dirty" situation is not conducive to providing the extra time and money that is needed to develop a valid research design. As a result, research designs are reserved for long term projects or excavations. Another part of the problem lies in the fact that there are very few regional, or other large scale, research designs in existence that would aid in the development of area specific designs. This has caused many designs to be based on data-specific questions from which processual level analysis is attempted (Rondeau 1981:33). Wide area research designs cannot be successfully developed without site specific data.

The various levels of focus should not be considered as distinct units. In order to be useful, one level must logically and easily flow into another. For example, site-oriented research questions should be developed through the investigation of data-focused considerations. The study of physical remains will be able to answer some questions by itself but its greatest value lies in the fact that such a study opens up newer lines of inquiry. Following these lines to their logical conclusion involves all of the levels of focus at each stage in varying proportions. A site-oriented focus builds on the data-focused research and begins to develop the questions that will form the basis of the succeeding levels. It is possible to narrow the focus so much that the results have little utility for further research at other levels.

Once the most appropriate level is decided upon, it is often easiest to define certain parameters within which to frame the research questions. These parameters should consist of a series of general categories such as environment, technology, transportation, social behavior, etc., that can be applied specifically to the level of investigation and related generally to the other levels. By dividing the areas of consideration into such manageable units, one can develop a manageable research design. This approach is used effectively by Tamez, et al. (1981).

The available data from pioneer oil and gas sites in Wyoming can be readily analyzed using this approach. Until more people become familiar with the site category, much of the work will be concentrated at the data-focused level. This is the level at which most contract archaeologists are most comfortable yet all too often the effort is spent in describing the physical remains without offering any form of analysis at the data level. Although physical descriptions are very important for any type of further work, it is almost impossible to develop meaningful research statements without also recording distribution and relative density and inferring past activity from these. For example, by looking at the type and frequency of different artifacts it is possible to delineate work areas from habitation areas and develop questions concerning intra-site spatial patterning and settlement analysis. In the course of study of one large site in Fremont County, Wyoming, it was learned that instead of using the standard steam boiler to power the drilling rig the workers had cannibalized a truck and adapted the engine for this purpose. This easily leads one to questions of technological innovation in the oil field and how it relates to economic conditions. These indications of areas for further study could easily be overlooked if the emphasis is placed on simply recording the data without trying to analyze what the data mean. Several types of questions can be asked at the data-focused level, such as:

1. What is the frequency of common artifacts being adapted to new purposes?

2. How are the artifacts distributed throughout the site and how does this relate to their function?

3. How does the actual artifact type list and density relate to the expected artifact type list and density?

4. How are sites formed? What determines what remains are found?

Site-specific analysis should be a mandatory part of every site report for it is at this level that coherent units of analysis are developed with which to build large scale designs. Many times, however, this level of analysis is weak at best and often absent. Some sites present a tremendous opportunity to learn about the daily life in the oil patch. It is possible to develop a general framework of the type of activities which occurred on site and make inferences concerning higher, more generalized, levels of analysis. An analysis of the artifacts found on site 48CR2143 (see p.52 for site summary) in combination with a historical documents search enabled the archaeologists to understand a great deal about the site as a functioning unit. Beyond the documentation of individual living areas and work areas, it was possible to see that this site functioned as a central camp providing manpower and facilities to several drillsites as part of an organized exploration program. The number and location of the hearths supported this assumption. The hearths were all constructed of high grade firebrick whereas many other known hearths scattered around the area were constructed of either a mixture of firebrick and regular brick or regular brick alone. This is an indication that the operation was relatively well financed. It was observed that a high intensity fire occurred at or near an equipment shed which was located near the drilling rig. This fire melted many of the bottles and several metal tools were deformed by the heat. In addition, although the documentary evidence indicated that the well drilled at this site was a gas well, evidence on the ground consisting of numerous cobbles which had one side coated with sun-baked crude petroleum indicated that either oil was encountered during drilling or a fairly large amount of oil was handled on site. All of this has been developed using a site-oriented focus during the initial recording of the site. Using the data and understanding developed from this and similar sites we can generate questions of a site-oriented nature to be used in the analysis of other historic oil and gas sites. We can, for example, take the questions generated for the data-focus and expand them to represent a site-focused orientation:

1. What do the function of the site and the degree of innovation have in common?

2. How does the internal spatial arrangement of the site (i.e., artifact, concentration, and feature distribution) relate to the function of the site and what can we infer about the daily life of the occupants from this relationship?

3. How are the site content, spatial arrangement, and function related to the socio/political and natural environment of its time?

The regional level combines data from several site-oriented data bases into a wide area synthesis. This serves to provide coherence to investigations in a given area by emphasizing research problems common to the whole area. Tamez, et al. (1981:36) summarize the four main benefits of regional research designs as follows:

1. Regional research designs are more holistic in their approach in that they treat cultural systems as units, often with reference to the environmental and cultural context. A

holistic approach is more likely to yield explanations for a given phenomenon since it expands the field of possible explanations.

2. The use of a regionally oriented design should advance cumulative research--research that builds on previous work--and should encourage updated syntheses.

3. Regional research designs promote efficiency. The important questions are agreed upon in advance, and the types of data needed to address those questions are defined. The significance of a particular site is more readily apparent if it can be demonstrated to have potential to address those questions.

4. A regional research design can be used as a "standing design" for cultural resource management initiated research. In this way, even small projects can contribute to addressing important questions, and the yield of information is maximized. When used in this way, the regional design must be continually updated as new information becomes available. It becomes a symbiotic arrangement where new questions are generated and old questions refined as new data is incorporated.

A regional research design can serve to provide a good background on which to develop individual focal points of research. It can also provide a solid base for developing the more abstract questions of the processual level. It must, therefore, include an overview of the present state of knowledge and outline both specific research questions and general areas of future inquiry.

Regional research designs for the pioneer oil and gas industry could address such questions as:

1. What is the relationship between the "perceived" environment (the natural environment including perceived constraints and opportunities for exploitation) and the technological and social developments related to the industry in the region?

2. How does technology interact with and influence the social and economic aspects of the Wyoming oil and gas industry?

3. What effect did the development of the industry have on the sociocultural development of Wyoming?

4. How did the national economic situation influence the development of the industry in Wyoming?

Investigations into such questions can provide numerous additional avenues of inquiry and help to define the current data base. They can also, as previously stated, lead to processual level research questions. At the processual level, "information from varied regions may be amalgamated and thence be addressed in questions about culture change and the behavioral nature of man" (Rondeau 1981:33). The study of the pioneer oil and gas industry provides tremendous potential for understanding more about questions addressed at this level. This can easily be illustrated by a brief look at the potential contributions of this study in relation to the area of culture change:

The utilization of Wyoming's petroleum has always been based on a real or perceived need. In the early stages, this need was primarily local in character as petroleum seeps were visited by Indians and early trappers and used in a wide variety of applications. As more people and equipment began traversing the area, the trappers would lead these people to the seeps where it would be used even more (i.e., axle grease, lubricants, etc.). Shortly thereafter various entrepreneurs began collecting oil and transporting it to specific distribution points for sale to travellers, among others. Throughout this early period, however, the resource had very little impact on people. Its everyday use was a normal part of a person's life and there was ample supply to meet demand. With the mechanization of the East and the continual increase in demand from numerous markets, it became profitable to deal in oil. The thought of vast riches to be had for the taking has always had a strange effect on the human psyche. Normal social constraints are strained to the point of non-existence. The boom and bust cycle progresses rapidly, sometimes repeatedly, in restricted areas and an entire subclass of transient workers develops. It is when the social fabric is stretched that we can best study the individual fibers. The boom and bust cycle of the early oil and gas industry in Wyoming has many of the elements of "Gold Rush" days and every bit of the activity of the "Wild West" but the entire complex of behavior, economic activity, technological development, etc., has different roots and evolutionary development. Some examples of the type of questions relating to such rapid culture change that could be addressed include:

1. What is the relationship between social authority (i.e., police, courts) and company authority and how does this affect behavior as the individual moves from established social centers to the frontier situation in the oil fields?

2. How does the rapid influx and outlay of capital affect

the existing permanent establishments?

3. How is the stress of a boom and bust cycle reflected in the behavior of inhabitants, transients, social institutions, etc.?

As can be seen from these rough examples, the historic record can provide important supporting data to the solution of the problems that are currently being examined in light of recent oil and gas development. In other words, the study of processual level questions has applications that go well beyond the concerns of traditional historical archaeology. The boom and bust cycle that began in Wyoming in the late 1880's has continued to repeat itself in very much the same way to the present day. A study of this aspect of the oil and gas industry's historical development may help in solving today's problems through increasing our understanding of the nature of the cycle and its effects on the people involved.

CHAPTER SEVEN

CONCLUSION

The oil and gas industry in Wyoming is a rapidly changing entity that affects the lives of virtually all the people living there today. It is easy to look at the activity going on today and forget the long and colorful history behind it. The technology and methods in use today have gradually developed from simple hand tools to massive rotary rigs. As this technology was developing, the industry was gaining an increasing importance in the Rocky Mountain area. From sporadic use by the Indians to an almost total dependence by the modern world, petroleum has been a major contributor to the shaping of the modern state of Wyoming.

This document was generated out of a need to give a better understanding of the role of the petroleum industry in the historical development of the state and to provide a basis for the preservation of the industry's historical remains. It was organized in such a way as to fulfill the needs of cultural resource managers through the process of identifying, recording, and evaluating oil and gas exploration related sites. Information necessary to complete each step of this process was provided in a logical progression from historical background to an overview of the current condition of these sites in the field, provision of guidelines for the treatment of oil and gas sites, and suggestions for future inquiry.

The first section of this thesis (Chapters Two and Three) was designed to provide a general background of the historical and technological development of the industry on the national and state levels. It is important to begin with this information for two reasons. First, it is assumed that the reader has little previous knowledge of the industry, its history, or the technology associated with it. The historical and technological overview can be used as an aid in evaluating the significance of a particular site in terms of the overall historical development of the industry and the state of Wyoming. Second, this section serves to develop the terminology necessary to appreciate the remaining sections of the thesis and to properly describe the sites in the field.

Once this base had been established, a discussion of the various types of sites that may be encountered in the field was presented. This discussion in Chapter Four builds on the previous section by emphasizing the artifactual content of each type of historic activity area as these can be seen in the field today. Each site type was examined and examples were provided. These examples also serve to illustrate the current condition of sites.

Chapter Five summarized the requirements for field identification and provides general guidelines for the evaluation of historic oil and gas sites. By using the background developed in previous chapters in combination with the guidelines developed in this chapter, a field archaeologist or historian should be able to adequately record and evaluate these sites. This would be a major step in stemming the rapid loss of significant data. The accumulation of data, per se, would not bring us any closer to an understanding of the period, however. This requires the development of specific research goals and methods of achieving these goals. Chapter Six presented a general overview of some of the theoretical aspects of the development of research questions and designs. Using the framework developed by Rondau (1981), potential avenues of research on historical oil and gas sites was presented. Using these research questions as a basis for future inquiry, it is possible that we may yet be able to gain an insight into the historical development of the state of Wyoming.

The petroleum industry has always played an important part in the economic and social arenas of Wyoming. Without the royalty payments and severence taxes to provide monetary support for state institutions, Wyoming would be an entirely different place in which to live today. Yet the industry has historically provided an even more direct and important benefit to the state. Lacking readily available sources of power (such as water power or wood fuel) which had been traditionally utilized in the East, settlers throughout much of the Great Plains were forced to gather buffalo chips and scrub wood or to transport wood a fair distance from the mountainous forests. As a result, many of the early settlements were clustered near the mountains.

With the development of the petroleum industry in the state, oil and gas fueled the development of the many small settlements scattered throughout the state. A review of the historical notes in Appendix 1 shows that much of the output of the early fields went into the rural and industrial development of these communities.

In view of the importance of the industry to the historical development and continued economic stability of this state (among others), it is perhaps surprising that so little attention has been paid to its history. This is a history that is rapidly disappearing owing to the continued development of the industry itself in association with numerous other destructive agents. It is perhaps no small irony that one day our modern industry will go the way of the old cable tool rigs and become another ghost of Wyoming's past as the petroleum reserves are depleted.

It is hoped that this document will provide a starting point for the proper evaluation of historic oil and gas sites. As with most cultural resources, this site category is in danger. A major contributor to this state of affairs is the local contract archaeologist who does not care to deal with historic sites or even those conscientious field personnel who attempt to record the site to the best of their abilities but because of their lack of familiarity with the materials incorrectly identify or evaluate it. This thesis has been oriented towards acquainting people with the available resource base and providing some avenues for further evalution and research. The investigation into the historical archaeology of the oil and gas industry has tremendous potential for those willing to undertake it. It is hoped that sufficient interest in the subject can be generated to promote additional investigation before its too late.

APPENDIX ONE

OIL AND GAS FIELDS IN WYOMING BEFORE 1940

The following listing is a compilation of data on all oil and gas fields which existed or had existed prior to 1940. The information was primarily taken from Espach and Nichols (1941) with additional information from Biggs and Espach (1960). The 1940 date is arbitrarily used to mark the break between the historical and modern periods of the industry. This appendix is provided as a quick reference to some important interpretive information for analyzing historic oil and gas sites in Wyoming. The data is presented in the following order.

1. Field Name and Location.

   Several fields have been known by a number of different names in geological and historical publications. The primary name is listed first with alternatives or additional names in parentheses immediately following. Then the locational information is provided as described in Espach and Nichols (1941).

2. Discovery Date.

   This date is almost always considered to be the date that the first commercial production well "came in" or was finished. In almost every case exploratory drilling had been conducted for several years before the discovery date. This date is important, however, due to the fact that the discovery of oil in commercial quantities sent shock waves of activity through the area and soon brought in many people, equipment, and roads which completely changed its character. Although exploratory drilling was an important part of the history of the industry and the state, it wasn't until a field went into production that it really produced any lasting affect.

3. Discovery Well.

The location of the well that resulted in the productive potential of a field being established is given as accurately as possible when it is known. Written records traditionally record well locations as standard legal locations. The physical remains of these wells could be considered to be some of the more significant sites in a field owing to their importance to the development of that field.

4. Notes.

This section provides some additional points of consideration when determining the importance of a field. Some of the types of data presented here include notes on the life of the field, use and distribution of the oil or gas, and any production or refining facilities associated with the field. A point to consider when reading through this section is that in numerous cases the oil and gas produced in Wyoming's fields went directly into the expansion and development of Wyoming's towns and industries. It provided a cheap source of energy at a time when the state most needed it.

Alkali Butte (Secs. 1 and 2, T33N, R95W, and Secs. 26, 35, and 36, T34N, R95W, Fremont County)
Discovered: 1920
Discovery Wel: SE¼, SW¼, Sec. 1

Allen Lake (Secs. 27 and 34, T23N, R79W, Carbon County)
Discovered: 1919
Discovery Well: NE¼, NW¼, Sec. 34
Notes: Commercial production was developed primarily from 1932-1933. The field supplied gas to the town of Medicine Bow. Gas was piped from the field to Laramie from 1933 but this was discontinued in 1937.

East Allen Lake (Secs. 17 and 18, T22N, R78W, Carbon County)
Discovered: December 25, 1936
Discovery Well: NE¼, SE¼, Sec. 18

Ant Hills (Secs. 19 and 30, T37N, R62W and Secs. 24 and 25, T37N, R63W, Niobrara County)
Discovered: 1928
Discovery Well: NE¼, NE¼, Sec. 25

Arminto (Secs. 17, 18, 19, and 20, T37N, R86W, Natrona County)
Discovered: 1917
Discovery Well: SE¼, Sec. 18
Notes: From 1932 at least until 1940 some gas has been produced from a well in the NW¼ of Section 20 (drilled 1932) for domestic consumption in Arminto.

Aspen (Secs. 3 and 10, T14N, R118W, Uinta County)
Discovered: 1903
Discovery Well: NW¼, NE¼, Sec. 10
Notes: Real production did not begin until 1927 with a well in the NE¼, NW¼, Sec. 10. By 1940 the wells had all been shut in except when they were pumped to furnish oil for drilling operations in the area.

Badger Basin (West half T57N, R101W, Park County)
Discovered: July 1931
Discovery Well: SW¼, NE¼, Sec. 17
Notes: This well attracted much attention because it was drilled with cable tools to a depth of 8723 feet.

Baxter Basin, North and South

North (T19N, Rs. 103 and 104W, Sweetwater County)
Discovered: November 1926
Discovery Well: NE¼, NW¼, Sec. 11, T19N, R104W

South (Tps. 16, 17, and 18N and Rs. 103 and 104W, Sweetwater County)
Discovered: August 1922
Discovery Well: NE¼, SE¼, Sec. 16, T16N, R104W
Notes: Small showings of oil and gas found in the areas as early as 1916. Commercial accumulations of gas were not proved until 1922. Gas from the north and south fields were piped to Salt Lake City, Ogden, and several cities in southwest Wyoming where it was used for domestic and industrial purposes.

Big Muddy (N½, T33N, R76W, Converse County)
Discovered: 1916
Discovery Well: NE¼, NE¼, Sec. 9
Notes: A large amount of gas was produced with the oil but virtually all of it was used in the development and production of oil. Most of the oil was piped to a refinery in Glenrock.

Big Sand Draw (NE¼, T32N, R95W, Fremont County)
Discovered: 1918
Discovery Well: NE¼, SW¼, Sec. 10
Notes: Casper and sugarbeet plants in Wyoming and Nebraska were supplied from the Big Sand Draw and Muskrat fields when the gas fields in the Lost Soldier district were shut in and the line from Lost Soldier to Casper was taken up. From 1922 to 1928 5 to 6 million cubic feet of gas a day were piped to Riverton, Wyoming where it was processed in an absorption gasoline plant and the residue burned in a carbon-black plant. In 1928, the manufacture of carbon-black was discontinued and the gasoline plant was moved to the Field.

Billy Creek (west half T48N, R82W, Johnson County)
Discovered: January 1923
Discovery Well: SE¼, SE¼, Sec. 17
Notes: Production began in 1930 when an 8-inch line was laid to Buffalo and Sheridan, Wyoming.

Bison Basin (formerly Buffalo Basin) (NW¼, T27N, R95W, Fremont County)
Discovered: 1923
Discovery Well: NE¼, SW¼, Sec. 17
Notes: Gas from the discovery well was used in drilling other wells. The field was virtually abandoned around 1930.

Black Mountain (NW¼, T42N, R90W to the SE corner of T43N, R91W, Hot Springs County)
Discovered: 1923
Discovery Well: SW¼, NW¼, Sec. 36
Notes: Oil is processed in a refinery at Thermopolis, Wyoming.

Brenning Field (See Douglas)

Bolton Creek (Secs. 3, 4, 9 and 10, T29N, R81W, Natrona County)
Discovered: January 1920
Discovery Well: SE¼, SE¼, Sec. 4
Notes: Most wells had been plugged and abandoned by 1938. Oil was trucked to Casper although for a short time it was transported from the field to Casper through a pipeline.

Boone Dome and North Boone Dome

Boone Dome (Secs. 9, 10, and 15, T35N, R85W, Natrona County)
Discovered: 1923
Discovery Well: NE¼, NW¼, Sec. 15
Notes: One well was used to furnish low pressure gas to Powder River, Wyoming.

North Boone Dome (Secs. 28, 29, and 32, T36N, R85W, Natrona County)
Discovered: 1917
Discovery Well: SE¼, SE¼, Sec. 29

Bunker Hill (Secs. 29 and 32, T27N, R89W, Carbon County)
Discovered: 1932
Discovery Well: SE¼, SW¼, Sec. 29
Notes: The discovery well was a dry hole with a good showing of gas.

Buffalo Basin (See Bison Basin)

Byron (The name Byron was used formerly in referring to the present Garland Field) (Center of the E½, T56N, R97W, Big Horn County)
Discovered: 1918
Discovery Well: NE¼, NE¼, Sec. 22

Notes: Gas from the field was piped to Lovell and Cowley, Wyoming for domestic consumption. Oil was piped to a refinery and loading racks just north of Lovell for transportation to refineries in Laurel and Billings, Montana and to the Elk Basin-Greybull pipeline system. Some oil was trucked to a refinery in Billings, Montana.

Circle Ridge (intersection of Tps. 6 and 7N, Rs. 2 and 3W, Fremont County)
Discovered: 1923
Discovery Well: NE¼, SE¼, Sec. 1

Cody Structure (See Shoshone)

Cottonwood Anticline (See Hamilton Dome)

Crooks Gap (Secs. 18 and 19, T28N, R92W and Secs. 13 and 24, T28N, R93W, Fremont County)
Discovered: 1925
Discovery Well: SE¼, SE¼, Sec. 13

Crystal Creek (W½, T54N, R93W, Big Horn County)
Discovered: 1919
Discovery Well: NW¼, NW¼, Sec. 8

Dallas Dome (Popo Agie in early reports) (Sec. 13 and the N½ of Sec. 24, T32N, R99W, Fremont County)
Discovered: 1884
Discovery Well: Murphy No. 1 well, SW¼, SW¼, Sec. 13
Notes: The Murphy No. 1 well was the first producing oil well in Wyoming drilled to a depth of 300 feet. Three wells had been drilled by 1886 but were abandoned due to the lack of markets. A pipeline was built in 1910 to a railroad at the Wyopo Siding.

Danker (See Polecat)

Derby Dome (Sec. 4, T31N, R98W, Fremont County)
Discovered: 1921
Discovery Well: SW¼, NW¼, Sec. 4
Notes: Oil was piped to the Dallas Dome Pipeline

Douglas (Brenning Field, Brenning Basin N½, T32N, R73W, Converse County)
Discovered: 1894
Discovery Well: See notes
Notes: Oil was first discovered during the digging of an irrigation ditch in the NW¼ of Sec. 16, T32N,

R73W. In 1896 two wells were drilled in Secs. 8 and 9. Much of the oil from this field was used during the construction of the LaPrele Dam but by 1912 only two wells were being pumped. A small topping plant was built in the field. The gas was used as fuel for drilling purposes and for domestic purposes at several ranch houses; by 1912, however, only three gas wells were producing and they supplied only enough gas for three ranches. The field was virtually abandoned by 1932.

Dry Piney (Secs. 6 and 7, T28N, R113W and Secs. 1 and 12, T28N, R114W, Sublette County)
Discovered: 1919
Discovery Well: NW¼, NE¼, Sec. 12

Dutton Creek (Secs. 1 and 12, T18N, R78W, Carbon County)
Discovered: 1927
Discovery Well: NW¼, SE¼, Sec. 1

Eight Mile Lake (See Hatfield Dome)

Elk Basin (Tps. 57 and 58N, Rs. 99 and 100W, Park County, Wyoming and Secs. 35 and 36, T9S, R23E, Carbon County, Montana)
Discovered: 1915
Discovery Well: NW¼, NW¼, Sec. 30, T58N, R99W
Notes: The oil is piped to a refinery at Greybull, Wyoming and the gas to Billings, Montana for domestic and industrial consumption.

Enos Creek (SE¼, T46N, R100W, Hot Springs County)
Discovered: November 1924
Discovery Well: SE¼, NE¼, Sec. 26
Notes: The area was tested in 1916

Ferris (East Ferris) (Sec. 25, T26N, R87W, Carbon County)
Discovered: 1919
Discovery Well: SW¼, NE¼, Sec. 25
Notes: Gas was previously sent to Casper through the Wertz-Mahoney-Casper pipeline which was taken up in 1937. The field was basically shut-in by January 1938.

Middle Ferris (West Ferris) (Secs. 26 and 27, T26N, R87W, Carbon County)
Discovered: 1919
Discovery Well: SE¼, NW¼, Sec. 26
Notes: By 1938 all wells were almost depleted and produced only enough for camp and field use.

Fourbear (NW¼, T47N, R102W to the center of T48N, R103W, Park County)
Discovered: 1928
Discovery Well: NW¼, NE¼, Sec. 29
Notes: The discovery well has been abandoned. Another well was produced only to furnish fuel for exploratory work in the area.

Frannie (Secs. 23, 24, 25, and 26, T58N, R98W, Park County)
Discovered: August 1928
Discovery Well: NE¼, NW¼, Sec. 25

Garland (Field originally called Byron) (SW¼, T56N, R97W, Big Horn County)
Discovered: 1906
Discovery Well: NE¼, SE¼, Sec. 33
Notes: Oil produced in 1907 and 1908 was used primarily in development work. Oil produced form 1909 to 1912 was refined in a small plant at Cowley, Wyoming. In 1915 a large gas well burned out of control for three months wasting an estimated three billion cubic feet of gas. In 1936 and 1937 another blowout wasted an estimated 20 billion cubic feet. From 1918 to 1920, over nine billion cubic feet of gas were consumed in the manufacture of carbon-black at a plant built at Cowley in the fall of 1917 and shut down in 1921. The first use of rotary equipment in Wyoming took place here in 1906 (unsuccessful).

Golden Eagle (Secs. 11 and 12, T45N, R97W, Hot Springs County)
Discovered: 1918
Discovery Well: NW¼, SW¼, Sec. 12
Notes: A carbon-black plant was operated in the field in 1923 and 1924 with the remainder of the gas piped to Thermopolis for domestic use. The field was abandoned by 1933.

Gooseberry (T47N, R100W, Park County)
Discovered: 1937
Discovery Well: NW¼, NW¼, Sec. 33
Notes: A dry hole was drilled in 1917 in the SW¼, SW¼ of Section 28.

GP (Secs. 9 and 16, T25N, R86W, Carbon County)
Discovered: 1919
Discovery Well: NW¼, NW¼, Sec. 16
Notes: Oil was pumped to the Ferris pumping station on the Casper-Parco pipeline.

Grass Creek (T46N, Rs. 98 and 99W, Hot Springs County)
Discovered: June 1914
Discovery Well: NW¼, SE¼, Sec. 18
Notes: At least 332 wells were drilled in this field in 1916, 1917, and 1918. A compression casinghead-gasoline plant started operating in 1918, processing about 1 million cubic feet per day until 1936 when operations were suspended. Casinghead gasoline was transported from the plant to the railroad at Winchester.

Little Grass Creek (Secs. 10 and 11, T46N, R99W, Hot Springs County)
Discovered: 1917
Discovery Well: NW¼, SW¼, Sec. 11
Notes: This well was shut in until 1925 when it was produced to supply gas for domestic consumption to Thermopolis.

Greybull (originally known as Peay Hill) (center of the W½, T52N, R93W, Big Horn County)
Discovered: July 1907
Discovery Well: NW¼, NW¼, Sec. 21
Notes: Real development of the field did not begin until 1915. Oil was processed at a small topping plant in the field.

Hamilton Dome (formerly Cottonwood Anticline) (Secs. 13, 14, and 24, T44N, R98W, Hot Springs County)
Discovered: September 1918
Discovery Well: SW¼, SW¼, Sec. 13
Notes: Oil was transported by pipeline to a tank farm at Winchester and thence to a refinery at Greybull.

Hatfield Dome (also known as Eight Mile Lake, Lake Valley Dome, and Hatfield Gas Structure) (Sec. 35, T20N, R88W and Sec. 2, T19N, R88W, Carbon County)
Discovered: 1923
Discovery Well: NE¼, NW¼, Sec. 2
Notes: Gas was piped to Rawlins for domestic use.

Hiawatha (T12N, Rs. 99 and 100W, Sweetwater County)
Discovered: October 1926
Discovery Well: SW¼, NE¼, Sec. 22, T12N, R100W, Moffat County, Colorado

Hidden Dome (SW corner T48N, R90W and SE corner T48N, R91W and NW corner T47N, R90W, Washakie County)
Discovered: September 1917
Discovery Well: SE¼, SE¼, Sec. 31, T48N, R91W
Notes: Reservoir was virtually depleted by January 1938. Gas was piped to Basin and Greybull for domestic uses with the excess going to the refinery at Greybull. Oil was piped to a refinery at Worland.

Hudson (See Lander)

Ilo Ridge (See Waugh)

Iron Creek (Secs. 10 and 11, T32N, R82W, Natrona County)
Discovered: 1917
Discovery Well: SW¼, NW¼, Sec. 11
Notes: Gas was piped to Casper from 1921 until 1923 when pressure dropped off. The oil was topped off at a small plant in the field.

Kirby Creek (Secs. 21 and 22, T43N, R92W, Hot Springs County)
Discovered: 1918
Discovery Well: SE¼, NE¼, Sec. 21
Notes: Oil is refined in a small plant at Thermopolis

LaBarge (Tps. 26 and 27N, R113W, Lincoln and Sublette Counties)
Discovered: 1924
Discovery Well: NW, Lot 7, Sec. 3, T26N, R113W
Notes: Oil from the field is piped to Opal on the Union Pacific Railroad.

Lake Creek (Sec. 2, T42N, R91W, Hot Spring County to Sec. 24, T43N, R92W, Washakie County)
Discovered: 1925
Discovery Well: NE¼, NW¼, Sec. 34, T43N, R91W

Lake Valley Dome (See Hatfield Dome)

Lance Creek (Northern part of T35N, R65W and the southern part of T36N, R65W, Niobrara County)
Discovered: March 1918
Discovery Well: NW¼, Sec. 36, T36N, R65W
Notes: Before 1926 a large volume of gas was blown to the air, but in 1926 a gasoline plant and a carbon-black plant were built in the field. The gasoline plant was of the absorption type with a daily capacity of 4.5 million cubic feet of gas. This plant was shut down in April 1936 and operations were taken over by a new plant processing 8 to 10 million cubic feet of gas daily. The residue gas was burned in a carbon-black plant which operated from January 1927 to March 1938. This plant used 2,372 to 3,000 million cubic feet of gas annually to produce 1.8 pounds per 1000 feet of gas from 1927 to 1932 and 2.25 to 2.5 pounds per 1000 feet of gas from 1933 to 1938.

Lander (Hudson) (Secs. 13, 24 and 25, T2S, R1E: Secs. 19 and 30, T2S, R2E, Wind River Indian Reservation, and Sec. 4, T33N, R99W, Fremont County)
Discovered: 1909
Discovery Well: near river in Sec. 3, T33N, R99W
Notes: Important discovery not made until January 1912 when a well in lot 2, Sec. 30 came in. About 46 wells were drilled from 1914 to 1920. Some oil was shipped by rail to a refinery at Casper and some was used as fuel by the railroad.

Little Buffalo Basin (NE corner, T47N, R100W and SE corner T48N, R100W, Park County)
Discovered: November 1914
Discovery Well: SE¼, NW¼, Sec. 2
Notes: Gas was transported through a 74 mile pipeline system to Greybull, Basin, Worland, Meeteetse, and occasionally, to Thermopolis where it was sold for domestic and industrial use.

Lost Soldier (Little Lost Soldier) (Secs. 2, 3, 10, and 11, T26N, R90W, Sweetwater County)
Discovered: June 1916
Discovery Well: NW¼, Sec. 11
Notes: The recovery per acre for this field is the largest of any in the Rocky Mountain area. The first pipeline from the field was built in 1919 to Fort Fred Steele on the Union Pacific Railroad. This line was abandoned in 1924 when a new pipeline was laid to a refinery at Parco, Wyoming.

Lox (Secs. 34 and 35, T37N, R86W, Natrona County)
Discovered: 1921
Discovery Well: NW¼, Sec. 35

MacMahon Dome (See Polecat)

Mahoney Dome (S part of T26N, R88W and the northern part of T25N, R88W, Carbon County)
Discovered: 1919
Discovery Well: SW¼, NE¼, Sec. 34
Notes: No wells were drilled after 1928. Until the fall of 1937 the gas was transported through the Wertz-Mahoney-Casper pipeline system to Casper.

Manhattan (See Rocky Ford)

Maverick Springs (T6N, R2W, Wind River Indian Reservation, Fremont County)
Discovered: June 1918
Discovery Well: SW¼, NE¼, Sec. 22
Notes: From 1918 to 1929 oil was either produced for development purposes or placed in storage. In 1937, 5500 barrels of oil was produced to supply a demand for fuel oil.

Medicine Bow (Big Medicine Bow) (SE part of T21N, R79W, Carbon County)
Discovered: June 1935
Discovery Well: SE¼, NE¼, Sec. 26
Notes: Seven wells had been drilled in the area prior to discovery. Oil was transported by pipeline to a loading rack at Medicine Bow. A crude oil stabilization plant was built in the field.

Midway (E half T35N, R79W, Natrona County)
Discovered: 1931
Discovery Well: NE¼, NE¼, Sec. 23
Notes: Oil is piped two miles to a pipeline transporting Salt Creek oil to Casper.

Moorcroft (area including Wakeman Field once known as Belle Fourche, Butte) (North part of T50N near the range line between Rs. 66 and 67W and extending slightly west of north to the center of T52N, R67W, Crook County)
Discovered: circa 1884
Notes: Lubricating oils were required for gold mining in the Black Hills and before a railroad was built into that area oil was collected from seeps in the vicinity of the Moorcroft Field. According to C. D. Ricketts in his 1888 Annual Report of the Territorial Geologist to the Governor of Wyoming (p. 43) this oil was "transported to mining towns in the Black Hills, where it commanded a ready sale as a lubricating oil at a price of $28 per barrel." Ricketts also reported that operations in this field were begun before 1888 and that oil was collected from more than a dozen springs. It was also pumped from one well 300 feet deep at a rate of five barrels a day. By 1936 the field was virtually abandoned.

Mule Creek (along line between Rs. 60 and 61W, T39N, Niobrara County)
Discovered: 1919
Discovery Well: SW$\frac{1}{4}$, NW$\frac{1}{4}$, Sec. 19
Notes: Most of the 40 wells in existence prior to 1940 were drilled prior to 1921. The wells had been shut in since 1930 except for sporadic periods of production. The oil was either piped to a railroad or was trucked from the field.

West Mule Creek (NE corner of T39N, R61W and the SE corner of T40N, R61W, Niobrara County)
Discovered: 1920
Discovery Well: SW$\frac{1}{4}$, SW$\frac{1}{4}$, Sec. 26
Notes: Some drilling was done in this field before 1920, generally to validate claims. Oil was refined in a small plant in the field.

Muskrat (upper half of T33N, R91W, NE part of T33N, R92W and the lower half of T34N, R92W, Fremont County)
Discovered: 1928
Discovery Well: SE$\frac{1}{4}$, SE$\frac{1}{4}$, Sec. 34, T34N, R92W

Naval Reserve No. 3 (Tps. 38 and 39N, R78W, Natrona County)
Discovered: October 1922
Discovery Well: SW$\frac{1}{4}$, SW$\frac{1}{4}$, Sec. 2, T38N, R78W
Notes: US government leased in 1922. Shut in and taken over by the Navy in 1927.

North Casper Creek (at the adjoining corners of Tps. 36 and 37N, R81 and 82W, Natrona County)
Discovered: Early 1925
Discovery Well: SE$\frac{1}{4}$, SE$\frac{1}{4}$, Sec. 26
Notes: Drilled as early as 1912, the field was not proven productive until 1925. Most of the drilling had been done in Sec. 36, T37N, R82W and Sec. 1, T36N, R82W. By June 1938, the oil wells had been shut down and gas wells supplied gas for camp use only.

Notches Dome (Secs. 3, 4, 9, and 10, T37N, R85W, Natrona County)
Discovered: 1918
Discovery Well: NW$\frac{1}{4}$, SE$\frac{1}{4}$, Sec. 10
Notes: First actual commercially productive well was completed in 1923 and located in the NE$\frac{1}{4}$, NW$\frac{1}{4}$, Sec. 10. All wells inactive after 1927.

Oregon Basin (Tps. 50, 51, and 52N, west half of R100W, Park County)
Discovered: August 1912
Discovery Well: NW¼, SW¼, Sec. 32
Notes: Development of oil limited by limited markets. Part of the oil was transported 14 miles to Cody and refineries in southern Montana. The remainder was trucked directly to refineries. Gas was transported by pipeline to Cody for domestic and industrial use. This was probably the first field in Wyoming developed with rotary equipment which was in general use by 1927-1929.

Osage (T46N and the southern part of T47N, Rs. 63 and 64W, Weston county)
Discovered: 1919
Discovery Well: SE¼, NW¼, Sec. 5, T46N, R63W
Notes: Oil production was at its peak in April 1931 during which all gas produced (2.5 million cubic feet per day) was blown to the air with the exception of ½ to 3/4 million cubic feet per day which was used in the field. Oil was piped to a refinery at Osage and to a loading rack for shipment by rail. Some oil was trucked to small refineries throughout eastern Wyoming, western Nebraska, and western South Dakota.

Peay Hill (See Greybull)

Pedro (intersection of Tps. 45 and 46N, Rs. 62 and 63W, Weston County)
Developed concurrently with the Osage Field.

Pilot Butte (south central part of T3N, R1W, Wind River Indian Reservation, Fremont County)
Discovered: 1916
Notes: Oil was transported through a pipeline from the field to Riverton, but the line was abandoned and, by 1940, the small production was refined at a plant in the field.

Pine Mountain (also known as Pine Dome) (SE corner of T34N, R84W and the SE¼ of T35N, R84W, Natrona County)
Discovered: 1914
Discovery Well: Sec. 36, T35N, R84W on the east side of the mountain
Notes: By 1937 the wells were plugged and the field was abandoned.

Plunkett (Secs. 23 and 26, T1S, R1E, Wind River Indian Reservation, Fremont County)
Discovered: 1906
Discovery Well: NW¼, NE¼ of Sec. 26 near an oil seep

Popo Agie (See Dallas Dome)

Oil Mountain (SE¼ of T33N, R82W, Natrona County)
Discovered: 1851
Discovery Well: None - oil seep in Sec. 28
Notes: The oil seep was located and owned by Kit Carson, Jim Baker, and half-breed Indians who transported the oil on ponies to the California (Morman) Trail; here it was sold at one dollar per quart to freighters and emigrants who mixed it with flour and used it for axle grease. About 1859, six shallow holes and pits were dug or drilled by "spring pole" near the seep but were barren.

Pitchfork (East half of T48N, R102W, Park County)
Discovered: 1930
Discovery Well: NW¼, NE¼ of Sec. 14

Poison Spider (NE corner of T33N, R83W and Secs. 7 and 18, T33N, R82W, Natrona County)
Discovered: 1917
Discovery Well: NW¼, NW¼ of Sec. 12
Notes: The gas and oil were formerly piped to Casper. For several years, however, most of the oil had been hauled by trucks. The products of this field were used primarily for the manufacture of road oils and the field is shut down in winter.

Polecat (also referred to as Danker and McMahon Domes or Big Polecat) (T57N, R98W, Park County)
Discovered: 1916
Discovery Well: SE¼, NW¼ of Sec. 27
Notes: Gas was piped to Frannie and Deaver for domestic consumption.

Little Polecat (Secs. 30 and 31, T57N, R98W and Secs. 25 and 36, T57N, R99W, Park County)
Discovered: 1922
Discovery Well: SE¼, SW¼ of Sec. 30
Notes: Gas was piped nine miles to Powell for domestic consumption.

Powder River (Secs. 23, 24, and 25, T36N, R85W, Natrona County)
Discovered: July 1917
Discovery Well: NE¼, SE¼ of Sec. 23
Notes: The field was virtually abandoned by 1938.

Quealy Dome (crest of dome lies in Sec. 13, T17N, R77W, Albany County)
Discovered: 1934
Discovery Well: SE¼, SE¼ of Sec. 13
Notes: A dry hole was drilled in 1921. A seismograph survey then was made, and the area was mapped more accurately, as a result Quealy dome was the first productive structure defined by seismograph in the Rocky Mountain area. In 1936 a pipeline was laid from the field to a railway loading rack at Rock River. From there the oil was shipped to a refinery at Parco (now Sinclair) Wyoming.

Rex Lake (Secs. 23, 24, 26, and 27, T16N, R77W, Albany County)
Discovered: 1923
Discovery Well: NE¼, NW¼ of Sec. 26

Rock River (also known as Rock Creek) (NE corner of T19N and SE corner of T20N, R78W, Carbon County)
Discovered: May 1918
Discovery Well: SE¼, SW¼ of Sec. 35
Notes: In 1921, a gasoline plant with a capacity of 3 million cubic feet was placed in operation to process casinghead gas. Up until April 1937, when the plant was shut down, it had processed approximately 10.25 billion cubic feet. Oil was piped to Rock River from where it was shipped by rail. The casinghead gasoline was transported by pipeline to Rock River.

Rocky Ford (also known as Manhattan) (Sec. 13, T52N, R62W, Crook County)
Discovered: 1909
Notes: The field was abandoned in 1935.

Saddleback Hills (See Simpson Ridge)

Sage Creek (also called Shoshone Oil Field) (T1N, R1W, Wind River Indian Reservation, Fremont County)
Discovered: 1909
Discovery Well: NW¼, SW¼ of Sec. 35
Notes: An oil seep in the NW¼ of Section 35 was first mentioned in reports in 1864 and attracted attention to this area when drilling was undertaken along the Shoshone anticline. By 1938, two wells in the field were shut in, one was being drilled, and all other wells had been plugged and abandoned.

Salt Creek (Tps. 39 and 40N, Rs. 78 and 79W, Natrona County)
Discovered: 1889
Discovery Well: Shannon #1 well
Notes: Salt Creek is the largest oil field in the Rocky Mountain region. Oil seepages were known to exist at Salt Creek before 1880. These were frequent stops for freighters, travellers and Indians of the area. From 1893 to 1890 about 15,000 barrels of oil had been hauled to Casper from the Shannon Pool, a northern extension of the field. Although some oil had been discovered in the shales above the First Wall Creek sands in 1906, the Salt Creek Dome did not attract the attention of oil producers until 1908 when a well drilled to the first Wall Creek Sand "came in" producing 200 barrels of oil a day. This well was plugged and abandoned in 1937. From 1911 to 1918 all gas produced in excess of that required for field operations was burned. In January 1918, the first gasoline plant with a capacity of 3 million cubic feet per day was completed. This plant was later enlarged, two other plants were built, and six "booster" plants were erected in the field so that by 1924 the gasoline plants had a total daily production of 60 million cubic feet. On May 1, 1924 when approximately 183 million cubic feet of gas were produced, 49 million were processed at gasoline plants, 15 million were used for fuel in the field and 119 million were being wasted. A program of returning excess gas to the oil sands was initiated in 1926 and by 1930 no gas was being wasted. During the early life of the Shannon and Salt Creek fields the oil was transported 40 miles to Casper by wagon with 16 to 20 horse teams hauling 30 to 35 barrels per load. Late in 1911 a 6-inch pipeline to Casper was completed with many others to follow. In 1925, gas from the field was used to power a hugh electrical plant in the field which made Salt Creek one of the first oil fields in the country to be powered totally by electricity. The electrical plant was shut down in 1958 and is now used as a lambing shed.

Shawnee (T32N, R69W, Converse County)
Discovered: 1934
Discovery Well: SE¼, SE¼ of Sec. 17
Notes: Most of the drilling has been done in Secs. 16, 17, 21, 22, 25 and 27. The area was drilled as early as 1925 and oil showed in several core holes drilled in 1930. Most wells were shut in with some gas being produced for drilling purposes.

Sheldon Dome (Secs. 8, 9, 10, 15, and 16, T5N, R2W, Fremont County)
Discovered: 1925
Discovery Well: NW¼, NW¼ of Sec. 15

Shoshone (sometimes called the Cody Structure) (West half of T53N, R101W, Park County)
Discovered: 1912
Discovery Well: SE¼, SW¼ of Sec. 21

Simpson Ridge (also known as Saddleback Hills anticline) (west side of T21N, R80W, Carbon County)
Discovered: 1923
Discovery Well: SE¼, NW¼ of Sec. 20
Notes: The field was produced until 1931 when the wells were mudded in. In 1936 and 1937, several wells were cleaned out and again placed on a producing basis. Two new wells were drilled. The oil was transported to Hanna by pipeline.

South Casper Creek (Secs. 2 and 3, T33N, R83W and Secs. 33 and 34, T34N, R83W, Natrona County)
Discovered: 1918 (gas)
1922 (oil) SW¼, NE¼ of Sec. 3
Notes: The gas was piped to Casper until the field was depleted in 1925. Some oil was piped or trucked to Casper where it was refined for road oil. The field was shut down in winter.

Spindletop (Secs. 5 and 6, T29N, R81W and Secs. 31 and 32, T30N, R81W, Natrona County)
Discovered: 1922
Discovery Well: SW¼, SW¼ of Sec. 32
Notes: Oil was trucked to refineries in Casper.

Spring Creek (Tps. 49 and 50N, R102W, Park County)
Discovered: 1930
Discovery Well: SE¼, SE¼, Sec. 11, T49N, R102W

Spring Valley (Secs. 12, 14, 22, and 26, T15N, R118W, Uinta County)
Discovered: 1900
Discovery Well: Oil showing in a water well in the town of Spring Valley
Notes: Oil seepages were known to exist in the area as early as 1847, oil from this source having been used by emigrants travelling west. In 1907 a 125-barrel refinery near Spring Valley in the SW¼, NW¼ of Sec. 24, T15N, R118W was put into operation. Oil from this facility was sold locally to help finance drilling operations and used domestically in Spring Valley. The refinery was operated intermittently for many years. In 1909, oil was shipped to Salt Lake City for refining.

Sunshine (North and South) (North - extending north and south through the center of T47N, R101W, Park County: South - center of the $N\frac{1}{2}$ of T46N, R101W, Park County)
Discovered: North: 1928
South: 1926

Thornton (also known as Upton-Thornton) (Secs. 32 and 33, T49N, R66W, Crook County and Secs. 4 and 5, T48N, R66W, Weston County)
Discovered: About 1915
Discovery Well: $SE\frac{1}{4}$ of Sec. 33
Notes: By 1938, all wells were abandoned or shut down. For a time a topping plant in the field processed crude oil for local consumption.

Torchlight (Center of T51N, along the line between Rs. 92 and 93W, Big Horn County)
Discovered: 1913
Discovery Well: Center of Sec. 24
Notes: Most of the drilling occurred from 1914 to 1916. By 1938, the field was virtually abandoned.

Lamb (North part of T51N along the line between Rs. 92 and 93W, Big Horn County)
Discovered: 1913
Notes: Field virtually abandoned by June 1938.

Wakeman (also known as Wakeman Flats and Moorcroft) (Secs. 17 and 20, T49N, R66W, Crook County)
Discovered: no later than 1919
Notes: The field is located in a belt or region of oil seeps and small oil wells as at Moorcroft and Thornton. By 1932, all wells (except one or two) had been abandoned.

Walker Dome (Secs. 4, 5, 8, and 9, T46N, R99W, Hot Springs County)
Discovered: 1929
Discovery Well: $SE\frac{1}{4}$, $NE\frac{1}{4}$, Sec. 8

Warm Springs (East Dome - Sec. 31, T43N, R93W and Sec. 39, T43N, R94W; West Dome - Sec. 34 and 35, T43N, R94W, Hot Springs County)
Discovered: 1916
Notes: Most of the drilling was completed by 1920. The oil was trucked to Thermopolis where it was refined.

<u>Waugh</u> (also known as Coal Draw Dome and Ilo Ridge) (Sec. 7, T44N, R96W, and Secs. 1, 2, and 12, T44N, R97W, Hot Springs County)
Discovered: December 1934
Discovery Well: SE$\frac{1}{4}$, NE$\frac{1}{4}$ of Sec. 12
Notes: The oil was trucked to Thermopolis where it was refined.

<u>Wertz</u> (Secs. 1 and 12, T26N, R90W, Sweetwater County and Secs. 6, 7, 17, and 18, T26N, R89W, Carbon County)
Discovered: 1920
Discovery Well: NE$\frac{1}{4}$, SW$\frac{1}{4}$ of Sec. 7, T26N, R89W
Notes: In 1921 an 89-mile pipeline for transporting gas was laid to Casper and was operated until the fall of 1937. Gas was piped to Casper as well as Parco where it was used as refinery fuel. An absorption plant of 30 million cubic feet capacity was built at Casper in 1922 to process the gas. In 1931 the plant at Casper was dismantled and an absorption plant was built in the Wertz Field and operated until the fall of 1937 when the Wertz gas field was shut in.

<u>West Ferris</u> (also known as East Mahoney and sometimes included in the Mahoney Dome Field) (SW corner of T26N, R87W and the SE corner of T26N, R88W, Carbon County)
Discovered: 1923
Discovery Well: SE$\frac{1}{4}$, SW$\frac{1}{4}$, Sec. 29
Notes: Gas transport same as Mahoney Dome.

APPENDIX TWO

MATERIAL AND CONSTRUCTION OF THE

STANDARD CABLE TOOL RIG

(Excerpt from Oil Well Supply Company 1884 Catalog
Pittsburgh, Pennsylvania)

Material Required For Complete Rig

In constructing a rig the following timbers, lumber, nails and irons are employed. The sizes of the timber may be exceeded, but should not be diminished (unless the Raifsnyder Rig Irons, figures 60 and 65, are used). If necessity compels smaller sizes, the deficiency must be supplied by extra bracing.

Table 1

Materials Used in Constructing a Rig

Type of Lumber, Purpose		Size, Inches	Length, feet
Hemlock Timber			
1	Mud Sill	10 x 12	12
1	Mud Sill	14 x 18	20
1	Mud Sill	14 x 16	12
2	Mud Sills	14 x 16	20
2	Derrick Sills	10 x 10	21
6	Derrick Floor Sills	8 x 10	20
2	Engine Mud Sills	14 x 16	12
2	Engine Cross Sills	10 x 10	8
1	Engine Block	18 x 20	9
1	Main Sill	16 x 18	30
1	Counter Sill	16 x 16	16
1	Tail Sill	10 x 10	9
1	Samson Post, at top, 18 x 18, at bottom	18 x 20	14
1	Bull Wheel Post (may be round)	6 x 6	14

Type of Lumber, Purpose		Size, Inches	Length feet
1	Walking Beam, 12 x 26 in centre, at ends	12 x 12	26
1	Dead Head Post (may be round)	7 x 7	13
1	Engine Sill Brace (may be round)	8 x 8	26
Hard Wood			
6	Foundation Posts	18 x 18	4
2	Bull Wheel Posts	10 x 10	11
1	Piece for Tail Post and Crown Pulley Block	12 x 12	10
1	Piece for two Jack Posts, and Knuckle Post	16 x 16	16
2	Pieces for Keys	3 x 5	16
1	Pitman, 4 x 9, tapered to	4 x 4	12
1	Plank for Caps and Snatch Block	2 x 12	12
Saw Mill Lumber (generally Hemlock)			
2	Samson Post Braces, also makes two Jack Post Braces	6 x 8	18
2	Samson Post Braces, also makes two Jack Post Braces	6 x 6	16
26	Pieces, principally for Derrick Corners	2 x 8	16
6	Pieces, principally for Derrick Corners	2 x 10	18
22	Pieces, principally for Derrick Corners	2 x 10	16
5	Pieces, First Tier Girths	2 x 12	18
6	Pieces, First Tier Girths	2 x 8	20
4	Pieces, Doublers or Strengthening Plank	2 x 10	24
8	Pieces, Second Tier Braces	2 x 6	18
40	Pieces Derrick Upper Girths	1¼ x 6	16

Type of Lumber, Purpose		Size, Inches	Length feet
12	Pieces, Engine and Belt House Sills	2 x 6	16
24	Pieces, Plates, Ladder, Rafters, etc.	2 x 4	16
800	Feet, board measure, of 2 inch Plank for Derrick Floor		20
4,000	feet inch Boards		16

Table 2

Nails

Pounds Used	Type Nails	Length, Inches
125	10d.	3
25	20d.	4
100	30d.	4¼

Table 3

Rig Irons

An outfit of Rig Irons consists of Shaft, Collar, crank, Wrist Pin and pair of Flanges with Keys and Bolts.

1	Stirrup, for Pitman
1	Set of Centre Irons, with Bolts
2	Gudgeons and 4 Bands
1	Derrick (or Crown) Pulley
1	Sand Pump Line Pulley
1	Five-inch Brake Band, Lever and Staple
1	Back Brake for Sand Pump Reel
6	Bolts, 3/4 inch, assorted
1	Pair Boxes for Band Wheel Shaft
1	Walking Beam (or Drilling) Hook
1	Sand Pump Reel, complete

Time

To erect a Carpenter's Rig, complete, usually requires from 30 to 36 days' labor. Experienced gangs, accustomed to each other, and working long hours, can sometimes do it in half the time.

Description of the Modern Method of Sinking Artesian Wells

The process of obtaining water, either salt or fresh, and of testing lands for minerals by sinking holes of small diameter, has been known for many hundred years.

In Europe it was first practiced in the Province of Artois, in the north of France, whence the name Artesian is derived. There is within the gardens of a former Dominican Convent, at Lillers, in that Province, a drilled well which has flowed continuously since the year 1126, and unmistakable traces of much more ancient ones are found in various countries, particularly in China.

Formerly it was a very difficult, tedious and expensive operation to drill a deep well, but now one can be put down two thousand feet at a tenth of the cost, and in less than a tenth of the time that was once required.

The modern manner is an adaptation of steam power to the method practiced for ages in China.

Free falling tools, suspended by a cable and worked by steam power, are used, the weight of the tool being so great as to give blows of sufficient force to pierce the hardest rock. The operation is often called boring, but wells are not bored. They are drilled.

In the Oil Regions of Pennsylvania and vicinity there have been sunk more Artesian Wells than in all other parts of the world together, and great industries have been created for manufacturing the apparatus and tools to readily and safely sink wells to great depths.

The Oil Well Supply Company, Limited, makes Rigs and furnished apparatus for wells of any depth. But when a well is to be sunk in a new locality, and it is uncertain what depth the drill must go, we would recommend only the best rig, the heaviest tools, and the strongest materials. We will describe, first, such a rig as is used for drilling over 1,000 feet. We would recommend the smaller rigs only for depths from 500 to 1,000 feet, and the portable rigs only to 600 feet, although in the hands of skillful men and under favorable circumstances, these depths can be greatly exceeded.

The standard diameter of Artesian Wells, which long experience has demonstrated to be the best for all purposes, is 5½ inches, and tools are generally made of that size, but our facilities are ample for supplying apparatus for any other diameter.

The materials to drill a deep well are, first, a Cable, usually 1-7/8 inches in diameter, and a Sand Pump Line, 7/8 inch in diameter, of a length sufficient to reach the full depth desired. (As the Cable and Sand Line stretch in use, a 1,000 feet cable will drill 1,100 feet).

Second: A set of Drilling Tools, sixty feet long, weighing about 2,400 pounds, and a Sand Pump or Bailer.

The object of the appliances above ground is to enable the Drilling Tools to penetrate the rock.

The location of the intended well having been determined, a space about 90 feet long by 25 feet wide should be cleared and levelled.

<u>The Carpenter's Rig</u>

By this name is designted:

First: The foundation timbers, the Engine Block, and its Mud Sills.

Second: The Samson Post, Jack Posts, and Reel Supports.

Third: The Walking Beam, Band Wheel, and Sand Pump Reel.

Fourth: The Derrick, with Bull Wheels, and Crown Pulley.

Fifth: An engine house for the protection of the engine from the weather. Where drilling is carried on during the winter or other inclement season, the lower part of the derrick is enclosed so as to protect the workmen.

<u>Foundation Timbers</u>

The accompanying diagram, [not reproduced in this thesis] shows all the foundation timbers, except the corner posts under the derrick and the engine supports. The mud sills, $A^{1, 2, 3, 4, 5}$ placed in trenches. The center line of the longest mud sill, $_2$ should be 12½ feet from the well hole. At an equal distance from K^2, the mud sill, K^4, should cross the point where the front jack post will stand. Six feet from that will be mud sill, K^5. K^1 is midway between K^2 and K^4, and the short sill K^1 is placed within the lines of the derrick. On these mud sills rests the main sill. All mud sills, except K^1, have gains two inches deep to receive sills.

The main sill is generally laid so that the samson post and front jack post, will have full bearings upon it, and if it is less than twenty four inches wide it cannot stand at right angles to the derrick. If it is two feet wide it can be laid in line with the well hole, by placing the samson post flush with one and the jack post flush with the other side.

The centre line runs from the middle of the round part of the wrist pin through the centre of the samson post, to the well hole, and on this line the walking beam must be mounted and vibrate, and to this line all the other parts, except the common sand reel, must be squared or lined.

The sizes given in the diagram may be exceeded, but not lessened, unless Raifsnyder Rig Irons are used, or unless extra bracing is provided.

After all have been put in place and carefully levelled, keys or wedges are driven into the gains, and the whole foundation is thus firmly fastened together.

Some 20 feet back of the main sill is placed the engine block, which needs to be firmly fastened, and generally a heavy beam eight or ten inches square is fastened between the engine block and the mud sill, K^5, or the end of the main sill.

Great solidity and freedom from vibrations are the objects to be attained.

Samson Post, Jack Post and Sand Reel Supports

The samson post should be 18 x 20 inches at the bottom, and 18 inches square at the top, and 13 feet high, dovetailed into the main sill, and held by properly fitted keyes, and braced by the braces, which are all set in gains and firmly keyed up.

The knuckle post, R, should be of hard wood, 16 inches square and three feet high. Its shape is shown in the diagram. It is keyed in a gain in the main sill, O, and the lever, r, should be of some tough and elastic wood. When pulled forward it holds the sand reel pulley against the band wheel, against the back brake.

The jack posts are dovetailed into their appropriate sills, and held by firmly driven keys, and the jack posts are braced in the same manner as the samson post. The rear jack post has a long brace from its top to the first beam of the derrick.

Walking Beam, Band Wheel and Sand Pump Reel

The walking beam is 26 feet long, 12 x 26 inches at its middle, where it rests on the saddle and is bevelled on its lower side to twelve inches square at its ends. At its front end, a slot two inches wide and ten inches deep is cut, in which the drilling hook is hung. The hook is set six inches from the end. The stirrup of the pitman is hung six inches from the other end. As six inches are thus taken from each end of the walking beam its effective length is 25 feet, which is the distance from the centre of the jack post to the well hole. Midway between these points is the centre of the samson post.

The band wheel is 9 feet in diameter, and its rim is 8 inches wide. It is connected with the pulley of the engine by a belt. It communicates power to all the movable parts of the apparatus. It must be a perfect circle, have a carefully finished face, and be accurately mounted.

It is fastened upon a shaft, which has at one end a crank or arm with several holes, in either of which (according to the length of stroke of the walking beam desired) is inserted a wrist pin to which is attached when necessary the pitman, which is connected by the stirrup with the walking beam. The rotation of the band wheel, therefore, causes a rocking motion of the walking beam.

On the side of the band wheel is bolted the tug pulley, which is lined with the grooved bull wheel in the derrick.

The common sand reel shaft is twelve feet long and ten and a half inches in diameter. It has both a brake pulley and a friction pulley.

Great care must be taken in hanging the sand reel, so that the bearing of the friction wheel is even with the face of the band wheel. The lever is pivoted in the knuckle post, R, about 12 inches above the main sill, and in the lever, r, is placed the gudgeon of the sand reel, about 12 inches above the pin of the lever.

A stick fastened on the centre of the sand reel shaft, at right angles to it, is lined with the sand pulley block, near the top of the derrick. This gives the proper angle of the sand reel shaft, the back end being raised or lowered as may be required for the sand pump rope to distribute itself evenly from end to end of the shaft.

The Derrick and Its Fittings

The derrick stands directly over the well, and is 20 feet square at the base, and 72 feet high, the four corners, F, converging so as to form a square at the top two feet ten inches inside diameter, upon which rests a heavy frame work, F, for the reception of the crown pulley over which the cable or drill rope plays.

The foundation posts support the derrick. Of these there are six, one at each corner and one midway between the corners on each of the two sides. These posts may be 18 inches square, and should be set firmly in the ground.

The two derrick sills are on each side of the derrick and rest upon the foundation posts. They should be 21 feet long and 10 inches square. On top of these sills are laid from side the floor sills, which are 8 x 10 inches and 20 feet long. Of these there are six, the two middle ones being one foot apart, and having the well hole between them. They are raised by blocking from the sills, two or three inches, causing the floor to slope both ways from the centre, so that it can be more easily kept clean.

The floor sills are bevelled at the corners to the slope of the derrick, and the corners started, the planks of which on the sides are 2 x 8 inches. Of these there should be sixteen pieces, each 16 feet long, and four pieces 10 feet long. The planks used on the ends are 2 x 10 inches, of which there are fourteen pieces 16 feet long, and four pieces 18 feet long.

In erecting the corners four pieces 10 feet long, 2 x 8 inches, are spiked to the bevelled ends of the sills, then the 18 foot lengths, 2 x 10 inches, are raised and spiked to the sills and also to the 10 foot lengths, thus forming a corner.

The lower girths of the sides are then nailed in position, the centre line of the girths being in line with the top of the 10 foot lengths; the girths and braces, being on the inside of the derrick.

The first row of girths, four in number, are of plank, 2 x 12 inches and 20 feet long. Planks for scaffolding are laid on these girths. The next set of uprights are raised, 16 feet long, and spiked to the upper portions of the 18 foot lengths. The second row of girths are put on, their centre line being at the upper ends of the 18 foot lengths. This makes the distance between the first and second rows of braces 8 feet, and as 16 foot lengths of both sizes are used up to the top or eighth girth the distance between the centre line of the several rows of girths will be 8 feet. From the eighth girth the 2 x 10 inch sides will require an 8 foot length each, and thus the proper height for the corner will be reached.

The top is formed of boards of three different widths, the first row, 18 inches wide, is nailed to the sides of the corners, the upper edge being even with the top of the corners. On the outside of this row is nailed, with the upper edge flush, a row of pieces, 6 inches wide.

On the top parallel with the ends of the derrick are fastened two pieces of 2 x 12 inch planks on which the crown pulley block rests.

The several rows of braces are put in place as fast as the girths are raised, excepting between the first and second rows of girths on the end nearest the samson post, where the braces are left in order to allow the walking beam to have free movement. At this part of the derrick two planks, 20 feet long, are used as braces; they are placed diagonally from the corners of the derrick to the second row of girths, their top ends being fastened one foot apart.

The second girth is sometimes cut through in order to allow the walking beam, when not in use, to stand with the pitman end down and sometimes it is raised a foot above the line of the other girths.

At the bottom of each side at the corners is spiked a 2 x 10 inch plank, 20 feet long, called a doubler or strengthener.

The sides of the ladder are formed of two pieces of 2 x 4 inch scantling, the steps are of boards, five inches wide and two feet long.

At the bottom of the derrick is the shaft, M^2, 13 feet long and 13½ inches in diameter, mounted on journals, and having on each end the bull wheels, MM, 7½ feet in diameter, between which, on the main shaft, M^2, is coiled the drilling cable, the outer end of which cable passes under the shaft, M^2, over the crown pulley, at the top of the derrick, and is firmly attached to the drilling tools. When these are to be withdrawn it is done by power applied to the bull wheel.

The bull wheel posts, M^1, should be of heavy, sound timber, of hard wood, at least ten inches square and 11 feet long. They are cut one-half way through about one foot from their lower ends. This is dressed out, leaving an extended tongue, permitting the bull wheel posts, M^1, to set in on the derrick sill, and the tongue is bolted to the sill. The upper ends of the posts have tenons formed on them parallel with and resting against the lower girth.

A short piece of 2 inch plank, say one foot long, is spiked at each corner at the back end of the derrick, over the first girth, and to these is spiked a plank overlapping the first back girth forming a recess four inches in width for the tenons of the bull wheel posts, M^1. The front post is set as near the front side as the slope of the corner will permit, and the back post is set the length of the bull wheel shaft from the front post. Holes are bored in the posts to receive the gudgeons of the bull wheel. These should be about six inches higher from the derrick floor than the diameter of the bull wheel. After the bull wheel is swung the posts are fastened at the bottom and the top by bolts. And the back post is also strengthened by a brace from its top by a plank or beam to one of the middle joists of the derrick.

The gudgeons of the derrick of crown pulley are set four inches from the centre of the top of the derrick toward the bull wheel end. As the crown pulley is 18 inches in diameter, this causes the groove of the crown pulley to be five inches from the centre of the derrick toward the samson post.

Engine House and Boiler House

These need not be particularly described, as they do not differ from ordinary constructions for such purposes.

One house may contain both engine and boiler. The engine should be at least 33 feet from the band wheel.

In winter the whole rig is enclosed so as to protect the workmen and machinery.

The Engine, Boiler and Connections

An engine for drilling an artesian well should not be less than fifteen horse power, having a cylinder at least nine by twelve inches, although smaller engines, in good hands and under favorable circumstances, can be used.

The boiler to supply the steam to the engine should not be less than twenty horse power.

The engine is securely fastened to the engine block and by means of its driving pulley and carrying belt, which is of four or five ply rubber eight inches wide, motion is communicated to the band wheel and through it to all other parts of the machinery.

The motion of the engine is under the control of the driller in the derrick for the throttle valve of the engine has a large grooved wheel attached to it, and from this grooved wheel the endless cord (called the "telegraph") extends to the derrick and passes around another grooved wheel, which may be fastened to the headache post, or some other convenient point within easy reach of the driller.

The link of the engine by which its motion may be reversed at will, can also be operated from the derrick by a cord, which passes over two grooved wheels, one fixed above the engine and the other in the derrick. A pull upon the cord raises the link and reverses the driving wheel of the engine. When the cord is slackened the link drops by its own weight, and the ordinary motion of the engine is restored.

Power from the engine is applied by means of a belt to the band wheel on the side of which is bolted the tug pulley, which has a groove, in which the bull rope rests. One of the bull wheels is a similar groove. The bull rope passes from bull wheel to band wheel, and by the rotation of the band wheel, power is thus communicated to the bull wheel, and the tools can be withdrawn. In order to give motion in proper direction to the bull wheel, the bull rope is always crossed. When the tools are lowered into the well they descend by their own weight. In order to check the rapidity of their descent the other bull wheel is provided with a brake, which consists of a strap of iron firmly fastened by a strong staple to the derrick floor, and passing over the bull wheel is so united to the brake lever, that pressing down upon said handle will cause the brake band to clasp firmly around the bull wheel.

The headache post is a strong post placed directly under the walking beam, so that in case the pitman, or saddle, should break, the front end of the walking beam would drop upon it, and thus be prevented from falling on the head of the workman, or doing other damage. If any repairs are needed to the crank or pitman, the walking beam can be tipped down and rested upon this post, or a block can be placed upon it, and the walking beam wedge up, if it is ever necessary to relieve the pitman of the weight of the tools while drilling.

The derrick floor requires 400 face feet (800 feet board measure) of two inch plank.

The sand reel handle is set near the headache post.

Attached to the derrick floor near the grooved bull wheel is a block swinging on a pivot having a projecting pin at one end, and at the other a cord long enough to reach to the man at the brake. The lever is so arranged that pull upon the cord will swing the pin against the bull rope and throw it off the pulley.

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